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ABSTRACT

This guide is designed to assist university professors in making decisions on their instructional planning and delivery by expanding and refining their repertoire of accommodations for their students with visual and hearing impairments, physical disabilities, and learning disabilities. Part 1 suggests a five-step procedure for making decisions on providing accommodations to students with disabilities. Steps include identifying individual needs, matching student needs with accommodations, implementing the accommodation plan, evaluating outcomes of accommodations, and utilizing the outcome. Part 2 presents accommodations not involving specialized materials and devices for students with different types of disabilities. Testing accommodations for students with disabilities are also addressed. Part 3 lists materials and devices that are not readily available to professors for their classes but have a high impact on accommodations. Short descriptions of these materials and devices are presented. Personal computer access problems and modifications to make the computer accessible to students with disabilities are also discussed. Appendix A includes Internet addresses of resource organizations and Appendix B provides examples of specialized materials and devices for accommodating disabilities. (Contains 62 references.) (CR)

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Accommodating Students with Disabilities

A PRACTICAL GUIDE FOR THE FACULTY

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THE AMERICANS WITH DISABILITIES ACT of 1990 (ADA) AND SECTION 504 OF THE REHABILITATION ACT OF 1973 AS APPLIED TO COLLEGES AND UNIVERSITIES: SOME POINTS TO REMEMBER

- Section 504 is a Civil Rights statute designed to prevent discrimination against individuals with disabilities. The ADA provides greater protections to individuals with disabilities. Colleges and universities must comply with the ADA. An institution may not discriminate against an individual solely on the basis of disability. *34CFR Section 104.44(d)(1) requires that an institution take such steps as are necessary to ensure that the individual with a disability is not denied the opportunity to benefit from or participate in the institution's programs.*

- For students, the institutions must provide reasonable accommodation to the student's known disability in order to afford him/her an equal opportunity to participate in the institution's programs, courses and activities including extracurricular activities. An example of reasonable accommodation is making facilities readily accessible to and usable by students with disabilities. However, the student has an obligation to self-identify that he/she has a disability and that he/she needs accommodation.

- An institution must provide a student academic adjustment (such as adaptation of course instruction and modification of test taking and performance evaluation) to ensure that the student receives an equal opportunity to participate. An institution must also provide auxiliary aids and services to students with disabilities (such as qualified interpreters and adapted equipment). However, an institution is not required to provide attendants, individually prescribed devices, readers for personal use or study or other devices of a personal nature. An institution is only obligated to provide tutorial services to students with disabilities in the same manner as it does to nondisabled peers. The institution may choose the methods by which the auxiliary aids will be supplied so long as the methods used provide an equal opportunity. The institution may not charge the student for necessary accommodation.

- The institution is not required to provide academic adjustments or auxiliary aids and services if such provision would fundamentally alter the nature of the program or the academic requirements that are essential to a program of study or to meet licensing prerequisites.

- The institution may not, except under specific circumstances described in implementing regulations, conduct preadmission inquiries as to whether an applicant has a disability.

- An institution must provide students with notice of the nondiscrimination requirements of Section 504. Students have a right to file a grievance with the institution. The institution's grievance procedures must provide the student with due process. Every college and university receiving federal financial assistance must have a compliance coordinator for Section 504 and every public college and university must have one or more compliance coordinator for the ADA.

- Facilities constructed after June 3, 1977, must be readily accessible and usable to individuals with disabilities. All programs and services must be provided in a manner that affords the student maximum integration with his/her nondisabled peers. Facilities constructed prior to June 3, 1977 need not necessarily be made accessible so long as the program or activity, viewed in its entirety, is readily accessible to students with disabilities. However, the student must be afforded an equal opportunity to enjoy the full range of services offered by the institution.

SOURCE: Kincaid, J., & Simon, J. (1994). *Issues in higher education and disability law.* Columbus, OH: AHEAD.

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1996

This document presents the results of an extensive literature search on ways and means of providing reasonable accommodations under the Americans with Disabilities Act for university students with visual impairments, hearing impairments, physical impairments, and learning disabilities.

ACCOMMODATING STUDENTS WITH DISABILITIES: A PRACTICAL GUIDE FOR THE FACULTY is part of Project AIM (Alternative Instructional Methods), a project funded through a supplemental award by the U.S. Department of Education, National Institute on Disability and Rehabilitation Research.

The project has three major objectives:

- To identify effective ways and means of accommodations that can be used for students with disabilities;
- To synthesize the findings in the form of non-theoretical summaries; and
- To deliver this information directly to professors at Alabama State University and other historically black colleges and universities.

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INTRODUCTION

The information contained in this publication is designed as a resource to assist university professors in making decisions on their instructional planning and delivery by expanding and refining their repertoire of ways and means of making accommodations for their students with disabilities. Sometimes common sense is not sufficient to make good decisions to better serve students with disabilities; a certain amount of information about the particular needs of a very heterogeneous group of students is needed in order to provide both physical and programmatic access.

The first part of this publication (PART I) will suggest a procedure for determining how to make decisions as to what, and how and under what circumstances certain ways and means of accommodations can be provided to students with disabilities. The procedure suggested involves five steps:

1. Identifying individual needs;

2. Matching students' needs with ways and means of accommodations;

3. Implementing the accommodation plan;

4. Evaluating outcomes of accommodations; and

5. Utilization of the outcome.

An example will be presented to show how the 5-step procedure may be used.

The second part of this publication (PART II) will present ways and means of accommodations without specialized materials and devices. Certain ways and means are used exclusively with certain types of disabilities; however, other types of ways and means of accommodations will be used across the categories of disabilities.

The third part of this publication (PART III) will list some of the important materials and devices that are not readily available to professors for their classes but have high impact on ways and means of accommodations. Short descriptions of these materials and devices along with pictures, where applicable and available, will be presented.

In order to facilitate reading of the text, citations were eliminated from the body of the text. However, references used for this publication are appended at the end of each section and again, at the end of this publication for those who want further information on certain topics. Furthermore, Internet addresses (APPENDIX A) were provided for those who wish to obtain more information by way of electronic databases.

PART I. THE 5-STEP ACCOMMODATION DECISION MAKING PROCEDURE

The following 5-step procedure may help professors in making better decisions when choosing accommodations for their students who have disabilities.

STEP 1. IDENTIFYING INDIVIDUAL NEEDS

Before providing accommodations, professors should know the specific needs of their students with disabilities and what options for accommodation are available to them. This necessitates data collection. Generally speaking, three types of data collection may be needed.

1. Professors need to have some general understanding about the specific disabilities that their students have. Needs and types of accommodations to be provided to students may be different based upon the disabilities presented.

2. Professors need to get specific information from their students with disabilities about their individual needs. Students' own suggestions, based on their experience with specific disabilities and with school work, are invaluable in accommodating disabilities. This is important because accommodations must be made according to the need of an individual student. Ask questions—what are some of the coping skills and adaptations that they have employed in the past. Students may be the single best source of information. Please note that identification of individual needs does not require precise measurements; it only suggests that collecting enough relevant data will help make better decisions concerning accommodation options.

3. Professors need to know about a variety of ways and means of accommodations available for their students. Knowing how to make accommodations, knowing what materials and equipment are needed in order to make such accommodations, and knowing what resources are available are all important.

STEP 2. MATCHING STUDENTS' NEEDS WITH WAYS AND MEANS OF ACCOMMODATIONS

Once enough data are collected, the next step is to weigh the options available before making decisions.

1. Professors should make the best choice from a variety of options, taking into consideration the university guidelines and policies with regards to accommodations.

2. Professors communicate to students with disabilities the options that could be made available.

3. If the choice is acceptable to their students, then more detailed plans will be made. If not, professors and their students need to discuss alternative accommodations and work out solutions that may be acceptable to both of them.

PLEASE NOTE that sometimes a dispute will develop between professors and students with disabilities. This type of dispute usually arises when students make certain requests and professors cannot or do not wish to accommodate their requests. Depending upon the nature of the dispute, if it appears to be difficult to resolve the issue, professors are advised to take the issue to the administration.

STEP 3. IMPLEMENTATING THE ACCOMMODATION PLAN

Once the choice is made and students with disabilities accept the choice, accommodations must be provided to students with disabilities according to the plan drawn up by both professors and students.

1. Professors write up the accommodation plan indicating the types of accommodations that will be provided to students, how those accommodations will be executed, and how the success of the accommodation plan will be evaluated. If special conditions are attached, those conditions should be spelled out specifically.

2. It is advisable that both professors and students sign the accommodation plan. This will eliminate a possible misunderstanding between the two parties. The plan usually includes, but is not limited to, types of accommodations to be provided, conditions under which those accommodations will be provided, if any, duration of the plan, and evaluation of the outcome of the plan. Responsibilities of both professors and students during the implementation of the plan must be clearly stated.

STEP 4. EVALUATING OUTCOMES OF ACCOMMODATIONS

Both professors and students need to get involved in evaluating the plan during and after the implementation of the plan.

1. It is desirable to periodically evaluate outcomes of accommodations while the plan is being implemented (on-going evaluation or formative evaluation). Either professors or students with disabilities may offer suggestions for possible modifications of ways and means of accommodation during the implementation process. Suggestions may be rejected with justification, accepted, or negotiated to make the plan and implementation process more effective.

2. Professors and students also need to evaluate the outcome of the accommodation plan and the implementation process at the conclusion of the plan (summative evaluation). The data obtained from the evaluation are invaluable in determining the course of action in the future.

STEP 5. UTILIZATION OF THE OUTCOME

Once the summative evaluation and data collection are complete, the next step is to decide how to use the data. There are three possible ways that the data may be utilized.

1. If the plan did not seem to work very effectively for the student, discarding the plan is a choice.

2. If the plan worked nicely but there appeared to be some room for improvement, appropriate modifications should be made to help the plan work better next time. With appropriate modifications the plan can be reused in similar situations with students with disabilities.

3. If the plan appeared to work fine and no modifications are necessary, then recycling of the plan next time for those students in similar situations would be an appropriate choice.

AN EXAMPLE

Susan is a sophomore majoring in reading. Susan's learning disability has been documented and verified by the university that she is attending. This semester she has decided to take a math course under Professor Smith. She came to her professor prior to the new semester and identified herself as having a learning disability. Susan tells her professor that she frequently reverses letters and numbers and she is experiencing note-taking difficulty. She also added that she has great difficulty taking tests—especially, writing for an essay test is a nearly impossible task for her to do. Susan specifically makes a request for test accommodations.

Professor Smith had little experience with students who have learning disabilities. She decided to use the 5-step accommodation decision making procedure to accommodate Susan's need. This is what she has done.

STEP 1.

Professor Smith gathered background information about learning disabilities before meeting Susan again. Having some general understanding about learning disabilities, Professor Smith talked with Susan to find out which types of accommodations worked best for her in the past in testing situations. Susan told her professor that she was able to handle multiple choice questions but not essay questions. She performed better when there were fewer questions on a single math test sheet. She added that transferring answers to a computer answer sheet was very difficult for her. Susan also told her professor that she usually had a hard time concentrating in noisy situations. She said that she almost always wished she had more time in testing situations.

STEP 2.

On the basis of the conversation with Susan and the background information about learning disabilities that she collected, Professor Smith made a list of options in order to accommodate Susan's needs in testing situations. Here are the options that she came up with:

1. **Test preparation plan for Susan**. A multiple choice test with no more than five questions on a single test sheet will be used. Instead of using a computer answer sheet, Susan will circle her answers directly on the test sheet.

2. **Test administration for Susan**. Double-time will be given to Susan to complete her test. She will be taking the test in a separate room free from noise and distraction. A proctor will be assigned to read the test questions as needed.

Upon completion of the tentative plan of accommodation, Professor Smith had a conference with Susan. The professor presented Susan with the tentative plan of accommodations and discussed the options with her. Susan stated that she was happy with the plan.

STEP 3.

Both Professor Smith and Susan signed the accommodation plan. The plan was implemented.

STEP 4.

Susan successfully completed the test. Both Professor Smith and Susan were happy about the outcome.

STEP 5.

Upon completion of the math course, both Professor Smith and Susan reviewed the outcome of the accommodation plan. They found that the accommodation plan implemented for Susan was very successful and no modifications were suggested. Both Professor Smith and Susan decided to recycle the accommodation plan for use during the next semester's math class.

PART II: WAYS AND MEANS OF ACCOMMODATIONS WITHOUT SPECIALIZED MATERIALS AND DEVICES

There are certain ways and means that professors can use in order to provide accommodations to their students with disabilities. Many of these accommodations can be made with no specialized materials or devices. Professors need only be exposed to the three types of information:

1. Background knowledge about disabilities;

2. Accommodations to be used in the teaching and learning process; and

3. Possible testing accommodations.

In the following a summary of these ideas will be presented. Professors are encouraged to find more information on certain topics as needed using relevant databases.

A. BACKGROUND KNOWLEDGE ABOUT DISABILITIES

Characteristics

In the following, some of the major characteristics of students with disabilities will be discussed.

Hearing Impairments

⇒ Students with hearing impairments differ considerably, and each student's case is unique.

⇒ Hearing impairments include partial to total loss of hearing. Two major types of hearing impairments are conductive and sensorineural. A conductive hearing loss results from abnormalities or complications of the outer or middle ear. A sensorineural hearing loss refers to damage to the auditory nerve fibers or other sensitive mechanisms in the inner ear.

⇒ The causes of the hearing impairments may be congenital (that is, born with a hearing loss), or adventitious (that is, normal hearing at birth but later became hearing impaired due to an accident or illness such as maternal rubella, prematurity and complications of pregnancy, meningitis, and otitis media).

⇒ The age of onset can have an impact on the student's ability to communicate. This is especially true if the age of onset occurred before the acquisition of language and the development of speech. Those who have not had the benefit of early language development may have language-based deficiencies such as poor syntax, trouble understanding abstract concepts, and poor vocabulary.

⇒ Many students with hearing impairments can and do speak, as most are born with normal speech organs. However, their speech can differ from hearing people's in tone, pitch, and loudness, and may be very mechanical and difficult to understand.

Visual Impairments

⇒ Visual impairments include partial visual loss and loss of vision. Students with visual impairments will often have partial sight; however, their vision may be blurred, cloudy, spotty, or double. Most students who are identified as legally blind do have some measurable vision or light perception.

⇒ To be considered legally blind, a person must have corrected vision that is limited to a narrow field of less than 20 degrees or his/her corrected vision must be no better than 20/200, that is, seeing at 20 feet what the average person sees at 200 feet.

PHYSICAL IMPAIRMENTS

⇒ Physical impairments are due to a variety of causes including spinal cord injury, cerebral palsy, severe arthritis, amputation, and multiple sclerosis.

⇒ One common result of many of these disabilities is paralysis or the loss of voluntary motor function. There are several types of paralysis, including monoplegia (partial or complete paralysis of one limb), triplegia (partial or complete paralysis of three limbs), tetraplegia (partial or complete paralysis of both arms and legs), paraplegia (paralysis of the lower part of the body), and hemiplegia (partial or complete paralysis of an arm and a leg of either the right or left side of the body).

⇒ Another frequent result of these types of disabilities is a loss of control over voluntary muscles in the arms, legs, tongue, or eyes that, in turn,

⇒ Another frequent result of these types of disabilities is a loss of control over voluntary muscles in the arms, legs, tongue, or eyes that, in turn, result in awkward movements, irregular gait, facial grimacing, or drooling.

⇒ Other physical manifestations of these disabilities might be difficulty with breathing, shortness of breath, and frequent coughing.

LEARNING DISABILITIES.

⇒ Learning disability is an umbrella term which includes a wide range of difficulties and manifestations. They vary widely within each category in the patterns they exhibit. More than 500,000 combinations of cognitive or socioemotional problems associated with learning disabilities are theoretically possible (Mercer, 1991).

⇒ Students may experience difficulty in information processing -- acquiring, storing, and/or retrieving.

⇒ Students with learning disabilities may find it difficult to perform tasks requiring critical thinking, problem-solving strategies, or an ability to deal with abstract concepts.

⇒ Students may not be able to focus or maintain attention.

⇒ Students may have difficulty expressing knowledge in a particular way or under the pressure of time limits.

⇒ Of presumed neurological impairment, it covers disorders that impair such functions as reading (dyslexia), writing (dysgraphia), and mathematical calculation (dyscalculia).

⇒ However, all students with learning disabilities have at least average overall intellectual ability

Major Problems Encountered

Some of the major problems encountered by students with disabilities are as follows:

HEARING IMPAIRMENTS

Communication is obviously the major problem. Hearing impairments may cause students not to hear or comprehend rapidly spoken information, such as procedural instructions, descriptive background, or questions posed by other students and answers given before the actual test begins.

VISUAL IMPAIRMENTS

Problems associated with visual impairments are also apparent. Visual impairments may cause students not to see or comprehend written material which may include announcement of test dates, procedural information, and content of the examination itself.

PHYSICAL IMPAIRMENTS

Access is one of the major concerns of students with physical impairments. Students must be able to find accessible routes from the parking lots to classes and offices. It may involve limitations in performing certain acts such as reaching and entering the exam site, sitting for long periods of time, and manipulating test materials.

LEARNING DISABILITIES

Academic problems may be seen in listening comprehension, reading, writing, or mathematics. Problems in nonacademic areas, such as lack of organization, impulsive decision making, lack of metacognition, lack of social-emotional control, can make academic life even more frustrating. In addition, visual perceptual problems which may include inability to discriminate figure-ground, sequencing and letter reversals, and similar shaped letters may preclude comprehension of printed test materials and/or completion of a standard answer sheet or essay examination in the usual manner.

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B. ACCOMMODATIONS TO BE USED IN THE TEACHING AND LEARNING PROCESS

The following guidelines should be useful in accommodating students with disabilities.

HEARING IMPAIRMENTS

The two major ways that students with hearing impairments communicate are oral (speech or lip reading) and manual (sign language). Speech (lip) reading is understanding of spoken language by watching lip movements of speakers and sign language is translation of oral communication into manual communication by an interpreter. Persons who communicate in the oral method use a combination of speech and speech reading.

Students who communicate using the manual method use the American Sign Language (ASL) system. This is a system of hand and arm movements, positions, and gestures that translates the spoken word into visual representations. ASL is a short-cut version and is not equal to the English language. Finger spelling may be used in place of the signs in case there are no equivalent signs for the words. This frequently happens when technical or subject-specific vocabulary are used.

USE OF SPEECH (LIP) READING

Certainly, speech (lip) reading (*see the definition above*) is one solution for some students with hearing impairments. However, the problem is that students who rely on reading lips can at best read 30 percent of the sounds of spoken English. Professors can help the situation:

- facing the student directly when speaking.

- speaking normally and naturally rather than exaggerating the lip movement when speaking.
- speaking clearly and concisely.
- speaking at a normal speed rather than speaking too fast.
- speaking directly to the student, not to the interpreter, if an interpreter is used.
- avoiding as much as possible talking as you write on the board with your back to the student.

USE OF SIGN LANGUAGE

Sign language is another form of communication often used by students with a profound hearing loss. However, it is very difficult, if not impossible, to take notes while watching an interpreter and reading the lips of a professor. Professors can help the situation by:

- providing lecture notes to the student.
- making arrangements with a student in the class who takes good notes and who is willing to help the student with hearing impairments by making a copy of the lecture notes.
- allowing the student with hearing impairments to videotap the lecture.

When students with hearing impairments are using lip reading and sign language, professors should avoid as much as possible, blocking the area around their mouths with their hands or other objects while talking.

USE OF WRITTEN COMMUNICATION

- Listing major topics of the lecture or discussion on the board or overhead projector is a good idea. Especially, use of an overhead projector enables professors to continue facing students while talking and presenting materials.

- Extensive use of handouts is helpful.

- Write on a piece of paper or on the board when it is necessary to communicate with students with hearing impairments.

- Consider using visuals--charts and graphs.

- If movies without captions are shown, written summaries or outlines of the movies are most helpful.

- Verbal assignments and due dates, exam dates, and changes of normal class schedule may be missed by students with hearing impairments. Written instructions should be given.

- Early in the term, provide a brief course outline.

SEATING

- Select a seat that gives the student a direct line of vision to the professor, the board or screen, and the interpreter.

USE OF AN INTERPRETER

- Allow an interpreter to sit or stand on one side of the professor, where the student can maintain eye contact both with the professor and with the interpreter.

- An interpreter is usually a few words behind the speaker and needs time to finish so that the student can respond. Give time.

- Hearing impaired students and interpreters experience visual and mental fatigue after a lecture of more than an hour and fifteen minutes. Let them take a break. This will enhance a student's chance of comprehending the lecture.

- If the class contains technical vocabularies, both interpreter and students must learn those vocabularies. It is more helpful to give the student and

the interpreter outlines of the lecture and/or written materials in advance of the class.

- In math classes where professors frequently use the chalkboard the interpreter must shadow the professor, that is, get close to the board that is being written on by the professor so that the student with hearing impairment can see the board and the interpreter at the same time.

- If the student is not using an interpreter, class discussion is hard to follow. Summarizing important points of the discussion and repeating questions from the audience are most helpful.

LIGHTING

- Providing good lighting is a must. Students with hearing impairments not only watch lip movements but also facial expressions, gestures, and other body language to communicate. Do not stand in front of a major light source such as windows. Shadows on the face make speech reading difficult.

- Only one person should talk at a time. Students with hearing impairments should face the speaker at all times.

USE OF NOVERBAL LANGUAGE

- Appropriate use of facial expressions, gestures, and other body language is helpful in conveying the message.

HEARING AID

- A hearing aid is virtually ineffective if the speaker is more than 3 to 8 feet from the hearing aid receiver. Furthermore, in many situations, persons with hearing impairments, even with an appropriate hearing aid, may have difficulty in understanding speech due to competing background noise. For professors, shortening the distance between the speaker and the listener and minimizing background noise as much as possible are much more effective than raising the voice. Never shout at hard of hearing persons who use hearing aids. They are sensitive to loudness and background noises. Noises are amplified by the hearing aid and interfere with communication with hard of hearing persons.

STUDENTS WITH VISUAL IMPAIRMENTS

There are certain accommodations professors can use in order to help their students with visual impairments in the classroom. Here are some examples:

ORAL COMMUNICATION

- Students with visual impairments depend almost exclusively on their hearing. Say what is being written on the board. Describe everything that is important to see. Instead of saying, this plus that equals this, one should say 1 plus 2 equals 3. New terms must be spelled.

TACTILE MATERIALS

- Try to find ways for students with visual impairments to touch instead of look at things, such as tactile charts and diagrams, if available.

KEEPING STUENTS INFORMED

- Students with visual impairments need to be shown and told about the new locations if furniture and equipment had to be moved around in the classroom or lab.

SEATING

- Partially sighted students should sit as close to the front of the class as possible to make maximum use of residual vision and auditory cues.

- Many students with visual impairments use adapted versions of the texts used in their classes. The three major types of adapted versions of the texts are enlarged books and books produced on microcomputer disks. Enlarged books are heavy and bulky. Books on disks can be viewed on a computer screen. The size of the type can be adjusted. Any page of the book can be printed out on paper and in braille. Instant voice-to-print and print-to-voice translations of documents are possible.

- The print in standard text can be enlarged on a closed-circuit television. Such modifications are essential for most students wih glaucoma, congenital cataracts, or nystagmus. However, for students with good central vision but a limited visual field, enlargements may be a hindrance. For those students, audiocassette versions of textbooks may be a better choice (Smith & Luckasson, 1995).

READERS

- Personal readers may be used. Personal readers are people who read aloud to those who are blind.

STUDENTS WITH PHYSICAL IMPAIRMENTS

There are certain accommodations professors can use in order to help their students with physical impairments in the class. Here are some examples:

SUBSTITUTION

- If a particular classroom or faculty office is inaccessible, find an accessible location or an alternate class section that is held in an accessible location.

CONSULTATION

- If a class involves field work or field trips, invite students with physical disabilities to take part in the selection of visitation sites or modes of transportation.

REARRANGEMENTS

- Classes taught in laboratory settings may need to be modified. It is possible to make more room by rearranging furnitures and equipment.
- Arrange seating so that students with physical disabilities will have the needed work space.

LEARNING DISABILITIES

There are certain accommodations professors can use in order to help their students with learning disabilities in the class. Here are some examples:

- Providing students with a detailed course syllabus at the start of the semester.
- Providing computer assisted software to supplement course work, if available.
- Making required book lists available prior to the first day of class to allow students to begin their reading early or to have texts put on tape.
- Providing students with chapter outlines or study guides that cue them to key points in their readings.
- Critiquing early drafts of papers, providing pointers and encouragement for follow-up rewrites
- Spelling out course expectations clearly before the course begins (materials to be covered, grading procedures, due dates, etc.).
- Meeting the student individually on a regular basis to clarify concepts and discuss class progress.
- Consider allowing students to complete in-class assignments outside of class.
- Consider alternative or supplementary assignments that may serve evaluation purposes, such as taped interviews, slide presentations, photographic essays or hand-made models.

- Encouraging students to develop note-taking skills even if they are not actively taking notes in the class. It is appropriate for professors to ask the student to sign an agreement not to release the recording of class lectures.

PRESENTATION METHODS

- Outlining class presentations by highlighting major concepts and terminology orally and visually--e.g., write and read aloud new terms, key points, and names on the board.

- Repeating and summarizing each segment of the presentation and again reviewing it in its entirety.

- Paraphrasing abstract concepts in specific terms and illustrating them with concrete examples such as models and visual structures (e.g., charts and graphs).

- Highlighting texts using color codes or supplementary symbols.

- Reading aloud material that is written on the board or that is given in handouts or transparencies.

- Keeping oral instructions concise and reinforcing them with brief cue words.

- Repeating or re-wording complicated directions when simplified directions cannot be given.

STUDY AIDS

- Consider allowing the use of dictionary, computer spell checks, a proofreader, or, in math and science, a calculator. In math, students may understand the concept, but make errors by mis-aligning numbers or confusing arithmetical facts.

- Allowing students to use a reader, scribe, note taker, word processor, tape recorder or typewriter.

- Making lecture notes or written outlines of lecture available.

- Assisting students, if necessary, in arranging to borrow classmates' notes.

ACCOMMODATIONS TO BE USED IN TESTING SITUATIONS

The intention of modifications in a testing situation is not to give a competitive edge to students with disabilities but to eliminate their competitive disadvantage by minimizing the impact of their disability on their performance. Reasonableness, mutually agreeable procedures, shared responsibilities, and institutional policies are all important in making adaptations for evaluation. Unless absolutely necessary, students should be allowed to take an adapted test in the same classroom at the same time with the other students. If the adaptation requires the exam to be administered in a place other than the regular exam site, efforts should be made to provide a setting which is equally conducive to concentration. Such a setting should be free from interruptions and distractions.

TYPES OF TEST ACCOMMODATIONS

EXTENDED TIME. By providing the extra time necessary to compensate for the disability, professors ensure that students with disabilities have an opportunity to show content mastery.

- This can be time-and-half, double-time, triple-time or more.
- The needed time varies with the constraints of the specific disability.
- The needed time varies with the type of subject matter.
- The needed time varies with the type of test.

READER SERVICES. A reader assists with reading information or transferring information to the test paper.

- Use of a human reader.
- Alternative: Use of tape readings of the test material.

SCRIBE SERVICE. A scribe dictates what should be written on the test paper.

- Use of a human scribe.
- Alternatives: use of word processor, spelling-checkers, grammar-checkers.

ORAL EXAMINATIONS. Unlike a written examination, oral examinations measure a student's ability to analyze, interpret, and respond to a question immediately. The additional time for thought that written exams provide, however, is sacrificed for the convenience of not having to use written words.

- Delineate the scope of the exam.
- Determine the format to be used in answering the exam questions.
- Determine the amount of detail that will be expected within a given time limit.
- The grading procedure and criteria should be spelled out in advance.

CALCULATORS. Make sure the use of a calculator is a matter of accommodation and not convenience when offering this option to students with disabilities.

ADAPTIVE EQUIPMENT. There are a number of options available for use in test accommodation. Examples are: a closed-circuit TV system for students with visual impairments, talking computers, talking calculators, and Braille printers. Students with disabilities usually possess this type of equipment. Access to a closed-circuit TV system may be limited in many institutions.

MODIFICATION OF TEST RESPONSE FORMAT. Modifications can be made in the following areas:

- Test format: essay, multiple-choice, true-false, fill-ins, etc.
- Size of the print.
- Size of the space allowed for response.
- Use of computer score sheets. For some students with disabilities, computer score sheets may be difficult or impossible to complete accurately and neatly. An accommodation for such students might involve having the student indicate the appropriate answer directly on the test paper and having a member of the staff transfer those answers to the computer score sheet when the student has completed the exam.

ENVIRONMENTAL CONTROL. Some students with disabilities cannot tolerate noises and distractions. They simply cannot concentrate on anything in a noisy environment.

- Students who are easily distracted may be allowed to bring sound-suppression earphones that block out extraneous noises.
- For students with disabilities who are aggravated by stress, provision of a private testing environment is an option.
- For students with disabilities who are on medication or whose energy level is fluctuating, the time of day for test administration is important. Consideration should be given time of test administration.

GRADING. When grading, not counting off for spelling errors, unless spelling is tested, is an option to take. Some students with disabilities experience great difficulty in spelling.

HEARING IMPAIRMENTS

- Students may be given written instructions or information ordinarily read aloud by the examiner.
- The oral or sign language interpreter may translate oral instruction and information.

VISUAL IMPAIRMENTS

- Arrange for a special edition of the examination, i.e., on tape, individually read, larger print, or Braille.

- Students may use electronic optical aids, such as a Visual-tek, which enlarge the print; or non-optical aids, such as an Optacan or a Kurzweil Reading Machine which change the form of the print to be usable for people with visual impairments. Usually students have the type of equipment.

- Students may record answers by typing or taping.

- Students may dictate answers to a proctor who marks the answer sheet or writes an essay.

- Where spelling and punctuation are related to course objectives, the student and instructor may determine a way for grammar to be evaluated within the parameters of the adaptation.

PHYSICAL IMPAIRMENTS

- Program accessibility can be achieved through a variety of methods such as relocating classes to accessible facilities, offering services in alternate locations, modifying buildings, or offering all programs in an accessible facility.
- Arrange for the exam to be given in an accessible building and classroom.
- Arrange for a proctor to assist for manipulation of test materials, marking exams, and writing numbers and/or symbols as directed by the student.
- Arrange for alternative methods of recording answers such as typing and taping.

LEARNING DISABILITIES

- Allow students to take exams in a separate, quiet room with a proctor. Students are especially sensitive to distractions.
- Grant time extensions on examinations and written assignments when there are significant demands on reading and writing skills. Factors to be considered in determining a reasonable time extension include type of accommodation (Device? Personal aide? Other?), examination format (Short answer? Multiple choice? Open book? Essay? Paper?), experience of the student (prior education or onset of disability), and purpose of the course (personal development? Career preparation?).
- Avoid overly complicated language in exam questions, and clearly separate them in their spacing on the exam sheet. For those students who have difficulty in transferring answers, avoid using answer sheets, especially computer forms.
- Make a variety of test forms available well in advance of the test so that students can choose.

- Consider offering students a variety of ways to demonstrate their knowledge and skills
- Consider substituting projects for exams.
- Consider accepting alternative projects.
- Try not to test material just presented since more time is generally required to assimilate new knowledge. Give students a reasonable opportunity to learn and demonstrate their skills.
- In-class assignments may be completed outside of class.
- Permit the use of dictionary, computer spell checks, a proofreader, or, in math and science, a calculator. In math, students may understand the concept, but make errors by mis-aligning numbers or confusing arithmetical facts.
- When necessary, allow students to use a reader, scribe, word processor, tape recorder or typewriter.
- Critique early drafts of papers, providing pointers and encouragement for follow-up rewrites.
- Consider alternative or supplementary assignments that may serve evaluation purposes, such as taped interviews, slide presentations, photographic essays or hand-made models.

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PART III. SPECIALIZED MATERIALS AND DEVICES FOR ACCOMMODATIONS

Specialized materials and devices have been developed to help persons with disabilities. In the following, barriers encountered by students with disabilities when they use computer technology and some possible solutions to those access problems have been discussed. Some of the examples of specialized materials and devices are listed in APPENDIX B along with pictures and short descriptions.

PERSONAL COMPUTER ACCESS PROBLEMS

The standard personal computer system can present barriers to students with disabilities. Some common access problems are found in the use of disk drive, keyboard, mouse, and monitor and screen. Those who have physical disabilities may find it difficult to insert diskettes, or turn on the power switch, or use the mouse, or keyboard. The screen display is not accessible to persons who are blind. Students with low vision may find it difficult reading a standard screen display. Although the screen display is accessible to students with hearing impairments, audible error messages or beeps must be converted to text so that they can read. Therefore, modifications are often necessary to make the computer accessible to students with disabilities.

SOLUTIONS

Generally, there are two ways that students with disabilities can use a microcomputer: one way is to develop special software to run on standard computers and the other way is to modify the computer itself to run any software. Adapting or modifying the computer is called 'transparent access.' Products currently developed used two different approaches to transparent access: one approach is modifying operating system software and the other approach is modifying computer hardware to allow students

with disabilities to use standard software. Since the operating system coordinates the computer's input and output, it can be modified to accommodate special adaptations. For example, changes can be made in the operating system so that the output sent to the screen will also be sent to a speech synthesizer or braille display.

There are two major types of hardware modifications: one type is simple modifications to the keyboard (such as keyguards and key latches), disk drives (such as disk loading trays), or computer screen (such as enlarging lenses being installed in front of the screen), and the other type is connecting special alternative keyboards (such as, optical lightbeam, expanded keyboards, speech recognition), disk drives, or alternative displays (such as enlarged images, voice output, braille display, screen reading programs and speech synthesizers).

A. ADAPTIVE MATERIALS AND DEVICES BEING USED BY STUDENTS WITH HEARING IMPAIRMENTS, VISUAL IMPAIRMENTS, PHYSICAL IMPAIRMENTS, AND LEARNING DISABILITIES

There exists a variety of specialized materials and devices designed for enhancing the functional ability of persons with disability. Although these materials and devices are not readily available for classroom use, certainly it would be helpful if professors had some basic information about the products and their availability.

There are some common modifications that may be used across categories. For example, speech synthesis can be used by students with hearing impairments, students with visual impairments, students with mobility impairments, and students with learning disabilities. Students who use speech synthesis can have the computer state what line the cursor is on and speak the words on that line, making almost all of the computer capabilities accessible to them. However, there are other materials and devices that are almost exclusively used by students who have specific types of disabilities.

B. ADAPTIVE MATERIALS AND DEVICES BEING USED ESPECIALLY BY STUDENTS WITH HEARING IMPAIRMENTS

The following devices and software are available for students with hearing impairments.

HEARING AID

In many situations, students with hearing impairments, even with an appropriate hearing aid, may have difficulty in understanding speech due to competing background noise.

CLOSED CAPTIONING

Closed captioning allows the viewer to read dialogue as it is captioned.

ASSISTIVE LISTENING DEVICES

Assistive listening devices are electronic systems that enable persons with hearing impairments to hear in environments in which they may sitting far away from the speaker or in which a great deal of added noise is present. These amplification systems overcome the negative effects of noise, distance and echo and improve hearing ability in large areas such as lecture and concert halls and in interpersonal communication situations such as small group discussions and television viewing. These systems—hardwire, loop, infrared and FM-- deliver the desired signal, such as a speaker's voice, directly to the ears or hearing aids of the listener.

SOFTWARE

AccessDOS (IBM, Inc.) and AccessWindows (Trace Research & Development Center) include a "Show Sounds" option which blinks the screen or puts a small musical note in the upper left-hand corner of the display when the computer makes a sound.

C. ADAPTIVE MATERIALS AND DEVICES BEING USED ESPECIALLY BY STUDENTS WITH VISUAL IMPAIRMENTS

The assistive technology available to students who are partially sighted or students who are blind is extensive. The cause of visual loss, the extent of loss of visual acuity, the quality of peripheral vision, and any other accompanying disabilities are important factors in determining appropriate devices to be used.

STUDENTS WHO ARE PARTIALLY SIGHTED

Screen Enlarger Utilities

Screen enlarger utilities (large print programs) enable students with visual impairments to enlarge the text and graphics on the computer screen.

Large Print Display

With special equipment and software, computer-generated text and graphics can be enlarged on the monitor or printer for persons with visual impairments. Special software can change or adjust color of the monitor, or reverse the screen from black on white to white on black for persons who are light sensitive. Anti-glare screens can make screens easier to read.

Here are some examples:

Closed Circuit Television (Telesensory Systems, Inc., 415-960-0920) magnifies a computer document onto a screen for easy reading by persons with visual impairments.

VISTA VGA (Telesensory Systems, Inc., 415-960-0920) and MAGic Deluxe (Microsystems Software, 800-828-2600) display enlarged print on an IBM-compatible screen. Screen Magnifier/2 (IBM Special Needs Systems, 800-426-4832) provides enlargement for the OS/2 operating system.

InLarge (Berkeley System Design, 510-540-5535) software enlarges the screen output while running most software available for the Macintosh. Features include a reverse screen utility, crosshairs to easily find the mouse pointer and a modifiable area of magnification.

Close View (Apple Computer, Inc., 800-776-2333) also enlarges screen output on the Macintosh computer.

MagniPORT (Microsystems Software, Inc., 800-828-2600). Pop-up screen magnification window that tracks mouse movements and magnifies up to 10x. Supports all displays and display resolutions.

STUDENTS WHO ARE BLIND

Screen Reader

Students who cannot use visual information will use the computer with the aid of a screen review utility. Screen reader utilities take the information displayed visually on the screen and make it available through alternative media, such as synthesized speech or a refreshable (paperless) braille display.

Some examples are:

JAWS for Windows (Henter-Joyce, Inc ., 800-336-5658). A flexible, Window-based screen reader. It also includes JAMAL macro language.

outSPOKEN for Windows (Berkeley Systems, Inc., 510-540-5535). This supports over 30 speech synthesizers and works with a variety of screen review packages for MS-DOS and Windows 3.1x.

Virgo (Telesensory Corp., 800-227-8418). Virgo and it's sister product Screen Power for Windows were created to provide braille access to Windows.

WINDTS (F.H. Papermeier GmbH & Co. KG Reha Division, Germany, +49-2304-8970). This is a software package that allows blind persons to access programs running under the Windows graphical user interface with Braille, using the BRAILLEX-2D Screen Braille display.

WINKLiNE (Speech Systems for the Blind, 800-865-3624). This program provides text-to-speech within the Windows environment using any multimedia sound card supported by Windows. It identifies icons, menus, and controls, as well as echoing words as they are typed or when they are written to the screen.

Braille Word Processing

Special braille printers interface with computers to take advantage of the word processing capabilities. Conversion of text to braille, and braille to text is possible. The text can be displayed on the computer screen or printed hard copy braille. Refreshable (paperless) braille is also available.

Some examples are:

Index Braille Embosser (Index Advanced) prints IBM-compatible computer output in Braille. Duxbury (Duxbury Systems, Inc., 508-486-9766) allows the computer to translate text into Braille format and send it to the Braille embosser.

Navigator Refreshable Braille Display (Telesensory Systems, Inc., 415-960-0920) provides a tactile Braille display of the IBM-compatible computer

screen, allowing the user to read what is on the screen 40 characters at a time

Tactile Forms

For those who cannot read any print regardless of size, there are various devices that convert printed letters to a tactile code of vibrating patterns or to braille.

Computerized Letter Recognition

Speech synthesizers and text-to-speech programs can convert words stored in the computer to speech, large letter displays, braille, or to tactile signals.

Scanners with optical character recognition can read printed material and store it electronically on computers. These data can be read using voice synthesizers or printed with braille translation software and Braille printer.

D. ADAPTIVE MATERIALS AND DEVICES BEING USED ESPECIALLY BY STUDENTS WITH PHYSICAL DISABILITIES

On-Screen Keyboard Utilities

This is a program for those who cannot use a standard keyboard but can use one or more switches, a point-and-click, point-and-dwell, or simple clicking interface using a mouse or a headpointer. A common use of this technique is to display a picture of a keyboard and allow the user to choose keys which will be typed into the current application. Variations in this category include Morse-code input systems and single- or double-switch systems.

Here are some examples:

Eek! (OMS Development, 800-831-0272). This is an on-screen keyboard for Windows that can be used in click mode.

GUS! Talking Keyboard for Windows GUS! (Communications, 604-224-6699). It combines an on-screen keyboard for typing into a large-print editing window, accompanied by digitized and synthesized speech. It works with any multimedia sound card.

HandiKEY For Windows (Microsystems Software, Inc., 800-828-2600). This is an on-screen keyboard for Windows which also includes word prediction, sticky keys and speech output.

Mouse Keys (World Communications, 510-656-0911). This is an on-screen keyboard for Windows which also includes word prediction. It supports French, German, Spanish, and Italian.

Voice Input Utilities

With voice input utilities, the computer can perform certain tasks by recognized spoken commands. Some products also support dictation that allows the user to enter large amounts of free-form text such as a letter. Most products recognize discrete speech but some products support continuous speech. Speech recognition (dictation) systems allow the user to dictate text into the computer by voice. A particular system is trained to recognize specific voices. Some voice systems include dictionaries, up to 120,000 words. Without having to use the keyboard, the user can dictate a fully corrected document at up to 70 words per minute. Voice also controls computer commands such as "save, cut, paste and print." These systems can also provide a method to create custom text macros that can enter large blocks of text with a single command resulting in greater efficiency. Here are some examples:

IN CUBE PRO Voice Command for Windows (Command Corp., Inc., 404-813-8030). This is a continuous speech-recognition system which can be used without modification by persons with disabilities for command-and-control of Windows-based applications.

IBM Continuous Speech System (IBM, 800-342-6672). This is a command-and-control utility supporting up to 1000 vocabularies. Available in six languages.

IBM VoiceType Dictation for Windows (IBM, 800-342-6672). This is a large-vocabulary system supporting up to 32,000 words at a rate of 70-100 words per minute with 97 percent accuracy.

VoiceUser (Cylogic, 206-283-8800). This is a speaker independent command and control interface for Windows-based applications. Pre-configured vocabularies and macros allow virtually anyone to start the program with little or no voice training.

DragonDictate for Windws (Dragon System, Inc., 617-965-5200). This is a large-vocabulary dictation system which is designed for completely hands-

free use. Dragon Dictate 30K provides voice control of an IBM-compatible computer using a microphone headset. Word processing can be done without using a keyboard.

Kurzweil VOICE for Windows (Kurzweil Applied Intelligence, Inc., 800-380-1234). This is a large vocabulary, speaker-independent voice recognition system for Windows. It supports voice input for dictation.

Windows Sound System (Microsoft Corp., 800-624-9400). It includes a feature called Voice Pilot which allows small-vocabulary command and control.

Keyboard Enhancement Utilities

Keyboard enhancement utilities are products which modify the behavior of the Windows keyboard to make it easier to use for persons with disabilities.

Some examples are:

Access Packs for Microsoft Windows and Microsoft Windows NT (Microsoft Corp., 800-426-9400). This provides a variety of features for persons with limited dexterity or who are deaf or hard-of-hearing: allowing single-finger typing of SHIFT, CTRL, and ALT key combinations; ignoring accidental keystrokes, and adjusting the rate at which a character is repeated when a key is held down.

Dvorak Keyboard Layouts (Microsoft Corp., 800-426-9400). This is for those who have difficulty using the standard iQWERTYi. There are three types of layouts: (1) for those who use two-hands; (2) for those who use left hand only; (3) for those who use right hand only.
HandiWORD and HandiWORD Deluxe for Windows (Microsystems Software, Inc., 800-828-2600). This program is for keyboard rate enhancement via word prediction and abbreviation expansion for Windows. Sticky-key utility is built into the software. Version 3.01.0 supports speech output of word choices and Deluxe version supports foreign languages.

Keyboard Modifications

Examples of low-tech keyboard modifications are **highlighters** (such as stickers, keycaps, labels to highlight important keys), **keyguards** (plastic overlays with finger-sized holes that are placed over a keyboard to prevent accidental key pressing), and **masks** (cardboard masks being placed over keyguards to show only the keys that work individual software programs).

Examples of system utilities

AccessDOS is a software program developed by the Trace Research and Development Center, University of Wisconsin-Madison (608-262-6966) with support from IBM (*see APPENDIX B*). It provides extended keyboard, mouse, and sound access for IBM DOS user's. It is especially helpful for those with disabilities. Some key features are:

StickyKeys. Allows the user to execute multiple key operation (such as SHIFT, CTRL, ALT) with a single finger or stick.

MouseKeys. Provides a way for users who cannot handle the mouse but who can press keys on the keyboard, to perform all the functions of the mouse. The keys on the numeric keypad are used to control all of the mouse functions.

RepeatKeys: Allows the user to adjust how fast the auto-repeat works, or to turn it off and eliminate the repeat function.

SlowKeys: Instructs the computer not to accept a key as 'pressed' until it has been held down for a specific length of time.

BounceKeys: Prevents double characters from being typed if the user bounces on the key when pressing or releasing it.

ShowSounds: Blinks the screen or displays a small musical note in the upper left-hand corner of the display when the computer makes a sound (for persons who are deaf or hard of hearing).

SerialKeys: Allows the user to control the keyboard and mouse functions from an external assistive device (such as communication aid) connected to the computer's serial port.

ToggleKeys: Produces a 'beep' to indicate when the Caps Lock, Num Lock, or Scroll Lock keys are activated.

Also available is Access Pack for Windows 3.0/3.1 from Trace Research and Development Center.

Keyboard Alternatives

When the standard keyboard does not meet the needs of the user, alternatives can be found.

Examples are Plug and Play (keyboards which replace the standard), ergonomic (which provides additional supports), compact/reduced keyboards, and enlarged keyboards. Large Print Keytop Labels (Hooleon Corp., 800-937-1337) double the size of standard keyboard labels to help persons with visual impairments locate keys.

Most individuals who are blind can use standard keyboards; however, Braille input devices are available. Braille key labels assist with keyboard use.

Keyboard Layouts

Examples are Standard (QWERTY), Alphabetical Order, and Dvorak (for left hand and right hand).

Standard input methods include standard keyboard, mouse, joystick, and light pen. Adaptive input methods include touchscreen, expanded and mini-keyboards, macros, Morse code, single or dual switch use, and communication aids.

Dvorak Keyboards: The keyboard is arranged in such a way that the most commonly used letters and keys are within close proximity of the home row. This arrangement decreases hand and finger movements and utilizes the stronger fingers to type the keys most often used. Separate Dvorak keyboards (Dvorak One-handed Left keyboard from Typing Institute for the Handicapped, 602-939-5344) are also configured for one hand typists.

Comfort KeyBoard: The standard keyboard is split into three sections, each of which tilts and rotates to any position.

Mini Keyboard (TASH, Inc., 905-686-4129): This small keyboard for an IBM-compatible personal computer allows full keyboard access to individuals with limited range of motion, and limited strength. Very little force is required to activate the keys and it can be activated with mouthstick or finger.

Expanded Keyboard (EKEG Electronics Co., 604-273-4358)

Expanded keyboard, a large keyboard (14"x24"), spaced far apart, that can be used on an IBM-compatible computer, is designed for persons with limited fine motor control. The keyboard is fabricated with a matrix of touch-sensitive switches beneath their membrane surface, that can be plugged directly or indirectly (with a special interface) into the keyboard port of a computer. The small individual squares can be grouped together to form larger keys to assist persons with disabilities who need larger key areas to focus on using the software. Only light pressure is required to activate the 11/2" square keys.

Keyguard (IBM version from TASH, Inc., 905-686-4129; Macintosh model from TechAble, 404-922-6768), is a template with a hole over each key of a standard keyboard to assist persons who have limited fine motor control in

accurately selecting keys. With the keyboard guard, the key repeat function can be disabled in such a way that those who cannot release a key quickly enough can avoid multiple selections.

Onscreen Keyboards

Onscreen keyboards are used with head pointing systems--head movements control the pointer, a receiver translates head movements, and the item is clicked with a switch. Onscreen keyboards focus at a single location, can be moved and re-sized, and can incorporate other features.

Switch Scanning System

In scanning input, lights or cursors scan letters and symbols displayed on computer screens or external devices. Persons who have severe mobility impairments can activate the switches with head, finger, foot, breath, etc. ScreenDoors (Madenta Communications, 800-661-8406) software puts an image of the keyboard on the screen. Typing is done by moving the cursor to the character on the keyboard image with the headset and puffing on the mouthswitch.

Mouse Modifications

Examples of mouse alternatives are Track balls and TouchScreens. A Track Ball (Kensington, Inc., 800-535-4242) is a pointer alternative that replaces the mouse on the Macintosh or IBM-compatible computer. Persons with fine motor control and/or range of motion limitations find a track ball easier to use than a standard mouse.

E. ADAPTIVE MATERIALS AND DEVICES BEING USED ESPECIALLY BY STUDENTS WITH LEARNING DISABILITIES

Some students with learning disabilities find adaptive devices useful—such as large print display, alternative colors on the computer screen, and voice output—even though they were originally designed for those who were visually impaired.

Special Software Features

Word processing features usually include talking text programs, enlarged text, sound effects, and spell/grammar checkers. A standard word processor can be a valuable tool for persons with dysgraphia (an inability to produce handwritten materials legibly). Inspiration (503-245-9011) is a brainstorming and writing tool that allows ideas and text to be represented graphically and converted to outline format. This is good for students with learning disabilities to organize information.

WordScholar (Henter-Joyce, Inc.). This is an educational software package for persons with learning disabilities. This software supports a variety of synthesizers such as DECtalk PC and sound cards like Sound Blaster. The software highlights and speaks by character, word, line, sentence, paragraph or full screen. It also works well with popular text based DOS applications like WordPerfect and Professional Write (Adaptive Solutions catalog).

Type'nTalk (Lorien Systems). This is a utility program that can be used with any Windows program in IBM compatible computers. It can speak on each letter as it is typed, speak on each word as it is completed, and speak each sentence as it is completed. Pieces of selected text can be spoken. The pitch, speed and volume of the voice are customizable. It can convert word processors into a talking version. Foreign language support is available.

The Talking Template for Word (Lorien Systems). This is a template for Microsoft Word for Windows version 6. It's features include: reading any

selected text, a given letter, line or word, speaking font type and size, and speaking page position.

Word Prediction Software

Word prediction software can reduce input demands for commonly-used text and keyboard commands. Word prediction software programs are designed to reduce the number of keystrokes persons with mobility impairments must make by predicting what will be selected next. For example, word prediction software anticipates entire words after several keystrokes. A window appears on the screen with word choices available; these choices are stored in a dictionary which is modified to meet the users needs. Word prediction software increases input speed. This program is also good for students with learning disabilities.

Co:Writer (Don Johnston, Inc., 800-999-4660) and Screen Doors (Madenta Communications, 800-661-8406) are word prediction software packages that operate on a Macintosh computer. HandiWORD (Microsystems Software, 800-828-2600) provides word prediction on an IBM-compatible computer.

Vocal Eyes (GW Micro, 219-483-3625) and JAWS (Henter-Joyce, Inc., 800-336-5658) screen reading software for the PC provide an interface to DOS-based applications for persons with blindness and visual impairments.

Keyboard Macro (abbreviation expansion) Software

Keyboard macro programs are designed to reduce the number of keystrokes needed and/or reduce the complexity of using a computer program by allowing the user to combine sequences of keystrokes together onto one or two user-selected keys.

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American Council on Education (1995). Measuring student progress in the classroom: A guide to testing and evaluating progress of students with disabilities. Washington, DC: HEATH Resource Center.

American Council on Education (1995). Students who are deaf or hard of hearing in postsecondary education. Washington, DC: HEATH Resource Center.

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Video Tapes

Assistive technology in the classroom. Nebraska Assistive Technology Project. P.O. Box 94987, Lincoln, NE 68509.

Inservice training video. AHEAD. P.O. Box 21192, Columbus, OH 43221-0912.

Jeff with expressions: Writing with word prediction software. NCIP.

Multimedia and more: Help for students with learning disabilities. NCIP. 55 Chapel Street, Newton, MA 02158-1060.

Reader/tape training. University of Wisconsin-Stout. Instructional Technology Services, Menomonie, WI 54751-0790.

The world of assistive technology. University of Buffalo, Center for Therapeudic Application of Technology, 515 Kimball Tower, Buffalo, NY 14214-3079.

Working together: Faculty and students with disabilities. DO-IT Project. University of Washington, 4545 15th Avenue, NE, Room 206, Seattle, WA 98105-4527.

Working together: People with disabilities and computer technology. DO-IT Project. University of Washington, 4545 15th Avenue, NE, Room 206, Seattle, WA 98105-4527.

"Write" tools for Angie: Technology for students who are visually impaired. NCIP. 55 Chapel Street, Newton, MA 02158-1060.

CD-ROMs

ABLEDATA (1995). NIDRR. 8455 Colesville Road, Suite 935, Silver Spring, MD 20910. ABLEDATA is a database of information on assistive technology and rehabilitation equipment designed to serve persons with disabilities and rehabilitation professionals.

CO-NET (1996). Trace Research and Development Center, S-151 Waisman Center, UW-Madison, 1500 Highland Avenue, Madison, WI 53705. CO-NET contains a collection of disability-related resource information – e.g., assistive products, disability services, legal rights, and funding information.

ECER CD-ROM (1996). SilverPlatter, 100 River Ridge Drive, Norwood, MA 02062. ECER contains a database of information on special education.

ERIC CD-ROM (1996). ERIC Facility. 1301 Piccard Drive, Suite 300, Rockville, MD 20850. ERIC is a database of information on education.

Personnel Training in Assistive Technology. The University at Buffalo, Center for Therapeudic Application of Technology, 515 Kimball Tower, Buffalo, NY 14214-3079.

APPENDIX A: **INTERNET ADDRESSES**

Abledata and the National Rehabilitation Information Center (NARIC) – disability and rehabilitation databases.
gopher://val-dor.cc.buffalo.edu .

The National Rehabilitation Information Center (NARIC) – information on particular disabilities and the projects funded by the National Institute on Disability and Rehabilitation Research.
http://www.naric.cm/naric/home.htmlXerox Adaptive Technologies
Zephyr

DO-IT Gopher server -- resources of general interest to persons with disabilities.
gopher://hawking.u.washington.edu.

Apple Computer's Worldwide Disability Solutions Group – information about various impairments and adaptive technology resources.
http://www.apple.com/disability/welcome.html/

World Friends – disability-related resources and text-based information.
hale.ssd.k12.wa.us/tony.www/world_friends.html
Adapt-1 – adaptive technology and libraries.
listserv@american.edu.
adapt-l@americn.edu.

Easi (Equal Access to Software and Information) – issues related to technology and persons with disabilities.
listserv@sjuvum.stjohns.edu.
easi@sjuvm.stjohns.edu.

Information, Technology and Disabilities – a quarterly electronic journal devoted to computer use by persons with disabilities.
listserv@sjuvm.stjohns.edu.
Edudeaf – discussion of the education of deaf persons.

listserv@ukcc.uky.edu.
edudeaf@ukcc.uky.edu.

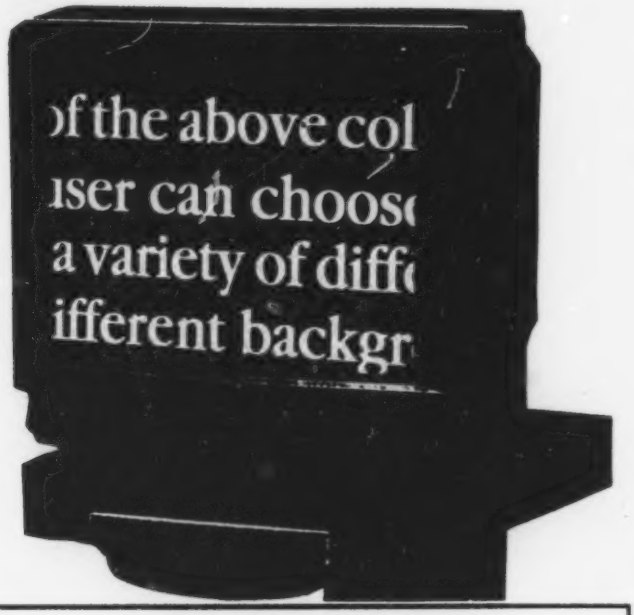
Tfa – international news service for persons who are deaf, hard of hearing, or affiliated with the deaf community.
rbweinstock@gallua.gallaudet.edu Deaf-magazine – a weekly periodical.
listserv@listserv.deaf-magazine.rg.

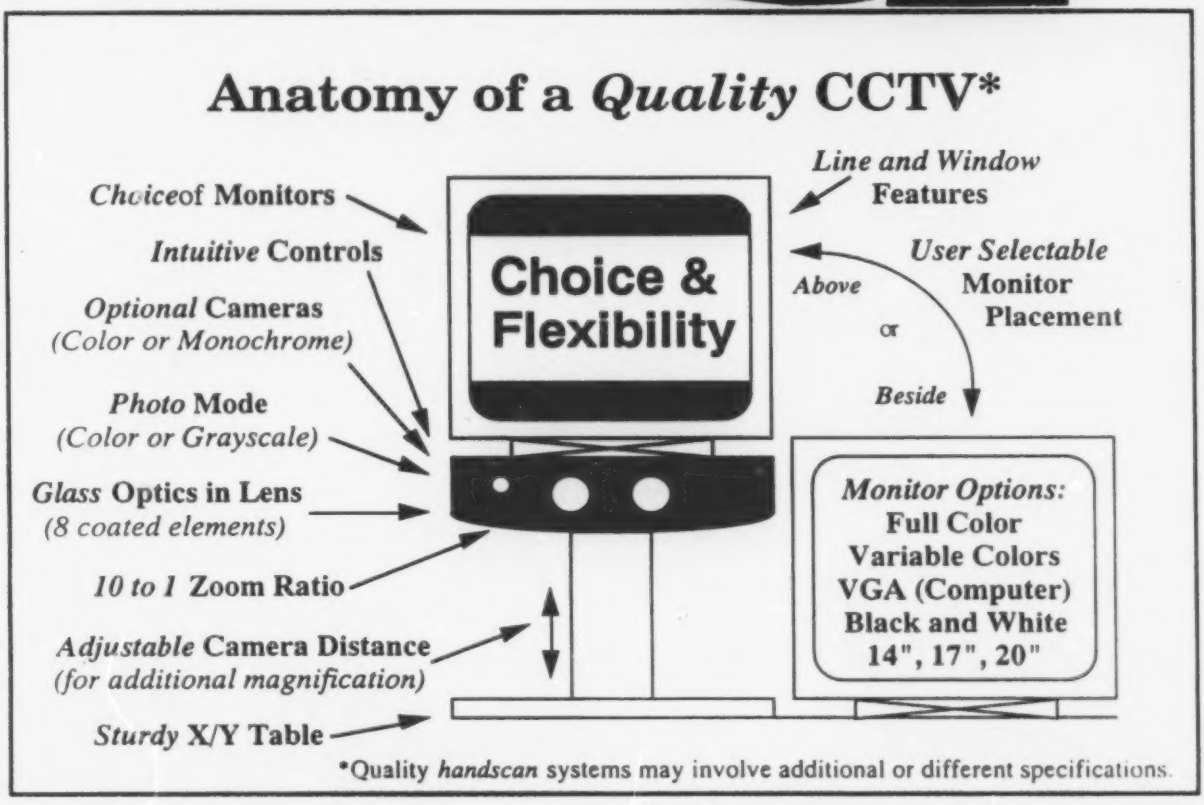
US National Library Service for the Blind and Physically Handicapped.
http://lcweb.loc.gov/nls/nls.html
Ld-list – learning disabilities information exchange list.
ld-list-owner@east.pima.edu.

Cornucopia of Disability Information (CODI) – disability-related information from a variety of areas.
Gopher val-dor.cc.buffalo.edu70

AXSLIB-L – library access issues for persons with disabilities.
listserv@sjuvm.stjohns.edu.

APPENDIX B: **EXAMPLES OF SPECIALIZED MATERIALS AND DEVICES**





LightWRITER SL35
Made in England by Toby Churchill Ltd.
DECtalk
INSIDE
conversation
SL35D shown FULL SIZE with Graphic Keyboard, Vacuum Fluorescent Displays, and DECtalk* Synthesizer Inside.

...ugmentative communication aid.

Ev... ...to very own sallent features. The ...ITER excels with these:

- **Forward facing display** for *natural face-to-face conversation*!
- **Easy to use** - *turn it on and type*!
- **It looks *good*!**
- **It's the *smallest* unit with DECtalk synthesis inside!**

- **TWO SCREENS†** - one facing you, and one facing the person or people you're talking to - *the "listeners" are drawn into the conversation the moment you strike the first key—and they interact without leaning over your shoulder.*
- **LARGE, CLEAR DISPLAYS** - Standard 3/8" (1 cm) high characters on the Liquid Crystal Displays are easy to read at a distance - *inside or outdoors* - back-lighting is optional as are bright Vacuum Fluorescent Displays with 1/4" (6 mm) high characters.
- **TWO KEYBOARD, TWO LAYOUT OPTIONS** - *graphic* or *rubber* keyboards for choice of appearance, feel, and tactile feedback - *QWERTY* typewriter layout or *ABCDE* straight alphabet - optional keyguards.
- **SMALL, LIGHTWEIGHT, RUGGED *and* ATTRACTIVE** - take it with you wherever you go.

- **BEST SPEECH SYNTHESIZER OPTIONS** - whether it's inside, attached, or external, the SL35 lets you choose a synthesizer ranging from the high quality of *male-*, *female-* and *child*-sounding **DECtalk** to others with a host of languages other than American-English. Speech exceptions ability is built in for making special words sound right.
- **MULTIPLE ACCELERATION TECHNIQUES** -
  - Listener anticipation due to the forward facing display.
  - 36 rapidly accessed Memos of up to 250 characters each.
  - Full abbreviation/expansion capability.
  - Word prompting after 1, 2, or 3 character input.
  - *Speedwriting...*
    speed of ***writing*** - *experience it!*
- **LOTS OF USER MEMORY** - 32-K of internal memory with 8-K fully backed up.
- **FACILITATED COMMUNICATION** - Very simple and easy to use - *turn it on, and use it like a typewriter.*

*DECtalk is a trademark of Digital Equipment Corporation.
†U.S. Patent 3,925,779

ZYGO

ZYGO INDUSTRIES, INC.
PO Box 1008
Portland, Oregon 97207-1008 U.S.A.
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U.S.A. / Canada: (800) 234-6008

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Typing Basic Keys (All Keyboards)

To type ordinary text characters - like letters, numbers, punctuation, etc, - all you have to do is select the character on your aid that you want to type and send it out the serial port of your aid.

The characters that you can type in this manner are shown on the keyboard below. They are the characters that are shown on the key caps of the non-shaded (white) keys in this illustration.

To type lower-case letters, or the lower of the two characters on keys that have two characters writtten on them, just type that key on your aid.

To type an upper case letter, or the upper symbol on a key, either send the upper case letter or symbol directly from your aid, or tell SerialKeys to hold the SHIFT key down and send the lower case letter. To find out how to press the SHIFT key, see the section on modifier keys.

Example 1

To type an "h", send a lower case h to SerialKeys. SerialKeys will type the

H key.

Example 2

To type an upper case "h" (H), send an upper case H to SerialKeys. SerialKeys will then hold the [SHIFT] key down while it types the

H key

or look in section on modifier keys to determine how to hold the [SHIFT] key and type the [H] key yourself.

Example 3

To type the exclamation point (!), select the exclamation point on your aid. SerialKeys will then hold the [SHIFT] key down while it types the

! 1 key.

Basic Keys shown here in white. Same for all keyboards, though a few may change location

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Typing Special Keys
IBM AT Keyboard (84 keys)

Here are three points to remember when programming locations on your aid:

1. The esc symbol is the Escape Character. It is a single character (ASCII 27). If the Escape Character is not already programmed into a location on the aid, it usually can be generated by selecting the **control [** (control left bracket) on your aid.

2. The shaded keys below are already programmed in most aids and can be typed as explained in the previous section.

3. The strings for the white keys below can be programmed into your aid in the same manner that you would program sentences.

Programming These Keys

☞ Setup a location in the aid in which to store a sentence.

☞ Find the key on the facing page. Above the key is the string. This is the "sentence" that must be stored in the aid.

☞ Spell out this string on the aid, character by character, starting with the Escape Character, then spell out the key name, and ending with a period.

☞ Exit the storing mode.

☞ Label this location with the name of the key.

Example 1

To type the 6 key on the keypad, program these characters into your aid:

esc kp6 .

Escape Character — Name of Desired Key — Period Character

(no spaces between the letters)

Then select this location on your aid.

Example 2

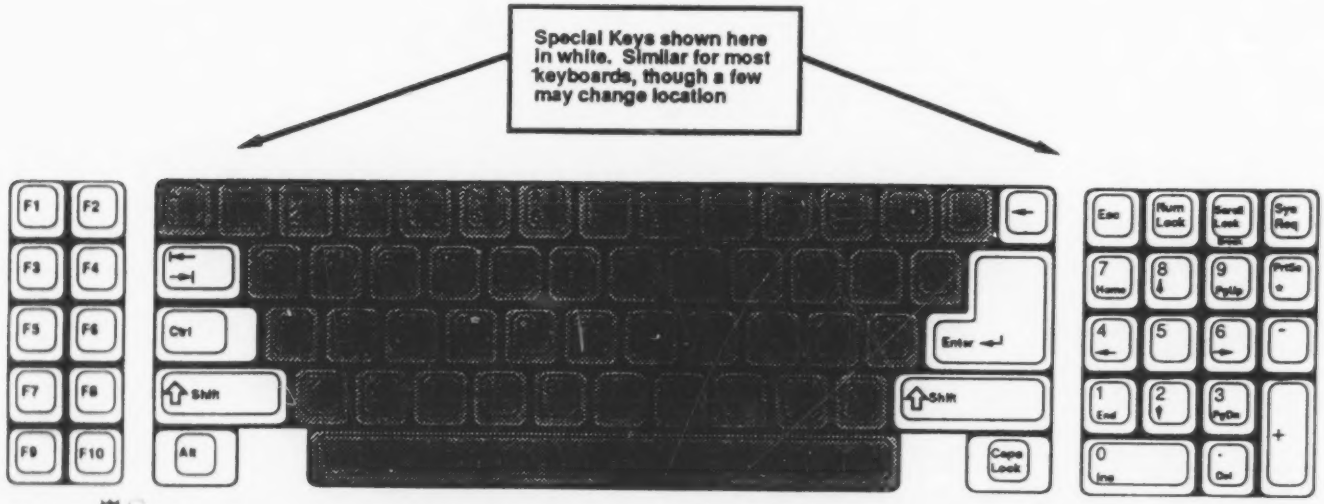
To type the F1 key:

esc f1 .

Escape Character — Name of Desired Key — Period Character

(no spaces between the letters)

After programming these characters into your aid, simply select the location.



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Typing Special Keys
IBM PC Keyboard (83 keys)

Here are three points to remember when programming locations on your aid:

1. The esc symbol is the Escape Character. It is a single character (ASCII 27). If the Escape Character is not already programmed into a location on the aid, it usually can be generated by selecting the **control [** (control left bracket) on your aid.

2. The shaded keys below are already programmed in most aids and can be typed as explained in the previous section.

3. The strings for the white keys below can be programmed into your aid in the same manner that you would program sentences.

Programming These Keys

- Setup a location in the aid in which to store a sentence.
- Find the key on the facing page. Above the key is the string. This is the "sentence" that must be stored in the aid.
- Spell out this string on the aid, character by character, starting with the Escape Character, then spell out the key name, and ending with a period.
- Exit the storing mode.
- Label this location with the name of the key.

Example 1

To type the 6 key on the keypad, program these characters into your aid:

esc kp6 .

Escape Character — Name of Desired Key (no spaces between the letters) — Period Character

Then select this location on your aid.

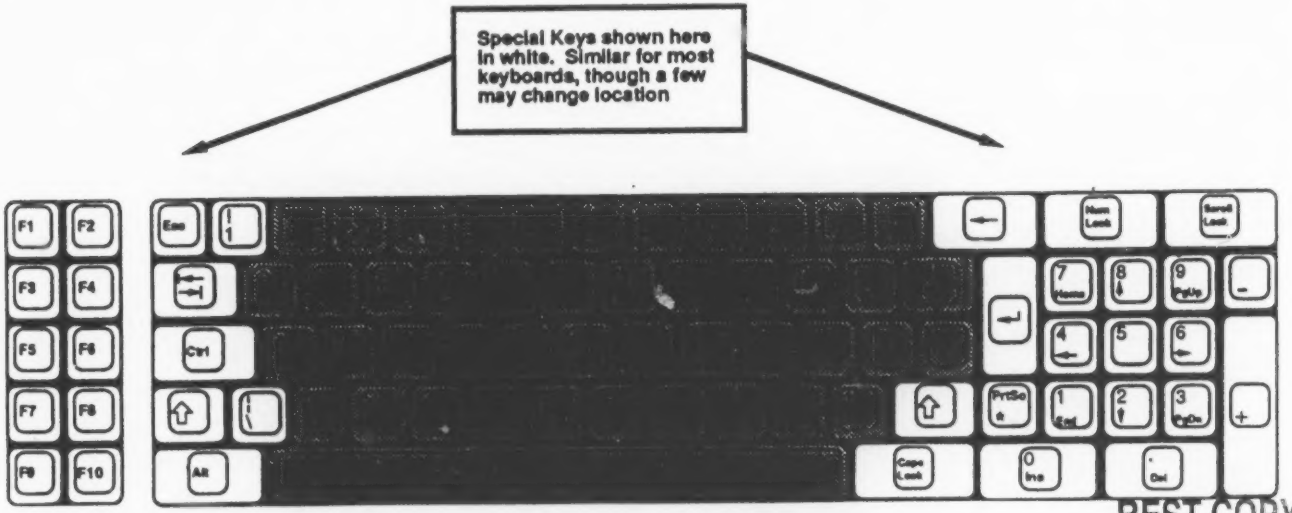
Example 2

To type the F1 key:

esc f1 .

Escape Character — Name of Desired Key (no spaces between the letters) — Period Character

After programming these characters into your aid, simply select the location.



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Typing Special Keys
IBM Enhanced Keyboard (101 keys)

Here are three points to remember when programming locations on your aid:

1. The ESC symbol is the Escape Character. It is a single character (ASCII 27). If the Escape Character is not already programmed into a location on the aid, it usually can be generated by selecting the **control [** (control left bracket) on your aid.

2. The shaded keys below are already programmed in most aids and can be typed as explained in the previous section.

3. The strings for the white keys below can be programmed into your aid in the same manner that you would program sentences.

Programming These Keys

☞ Setup a location in the aid in which to store a sentence.

☞ Find the key on the facing page. Above the key is the string. This is the "sentence" that must be stored in the aid.

☞ Spell out this string on the aid, character by character, starting with the Escape Character, then spell out the key name, and ending with a period.

☞ Exit the storing mode.

☞ Label this location with the name of the key.

Example 1

To type the 6 key on the keypad, program these characters into your aid:

ESC kp6 .

Escape Character | Name of Desired Key | Period Character

(no spaces between the letters)

Then select this location on your aid.

Example 2

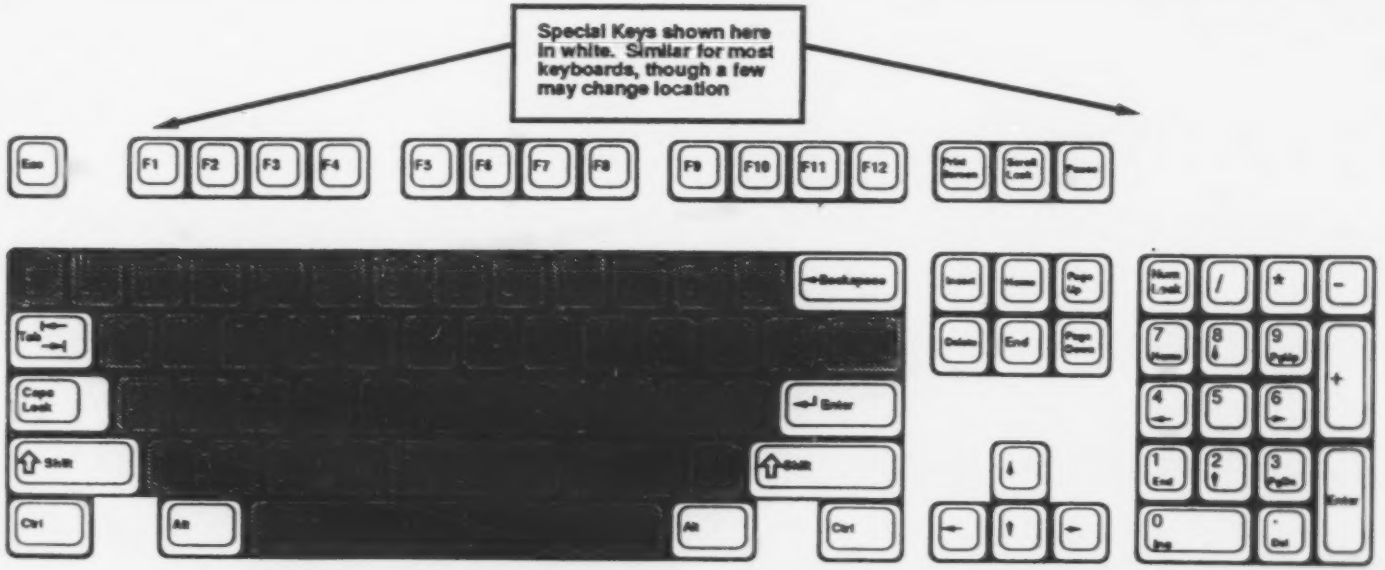
To type the F1 key:

ESC f1 .

Escape Character | Name of Desired Key | Period Character

(no spaces between the letters)

After programming these characters into your aid, simply select the location.



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Holding Modifier Keys with Other Keys

Often times it is necessary to hold a key down while typing another key. For example, holding the SHIFT key and typing a letter key to get an upper case character.

The keys, like the SHIFT key, that this is done most often with are called modifier keys.

The modifier keys for this keyboard are shown in the figure below. Associated with each key are the character strings you will have to program into your aid to use them in the fashion described above.

Programming These Keys

☞ Setup a location in the aid in which to store a sentence.

☞ Find the modifier key on the keyboard below and the associated string. This is the "sentence" that must be stored in the aid.

☞ Spell out this string on the aid, character by character, starting with the Escape Character, followed by the comma, spell out **hold**, then a second comma, spell out the name of the key as shown, and end with a period.

☞ Exit the storing mode.

☞ Label this location with the name of the key.

How To Use These Keys

When this string is sent, SerialKeys will wait until you select a second key. Upon receiving this second key, SerialKeys will hold the selected modifier key down, type the second key, and finally release the modifier key.

Remember that the modifier key will only act on this second key and that it will not hold the modifier key down until it receives the second key. Also, realize that SerialKeys will automatically release the modifier key.

Example 1

To hold the CTRL key down and type the S key (a sequence used in DOS to pause) you would first select the location you programmed the hold ctrl function into, then select the location that the S key is programmed into.

SerialKeys will hold down the CTRL key, type the S key, and finally release the CTRL key.

Example 2

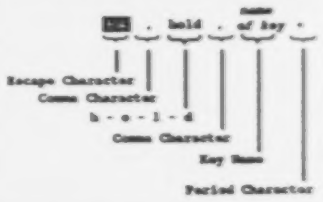
To type a capital h, either select a capital h on your aid or:

Select the location where you programmed the hold shift function, then select a lower case h.

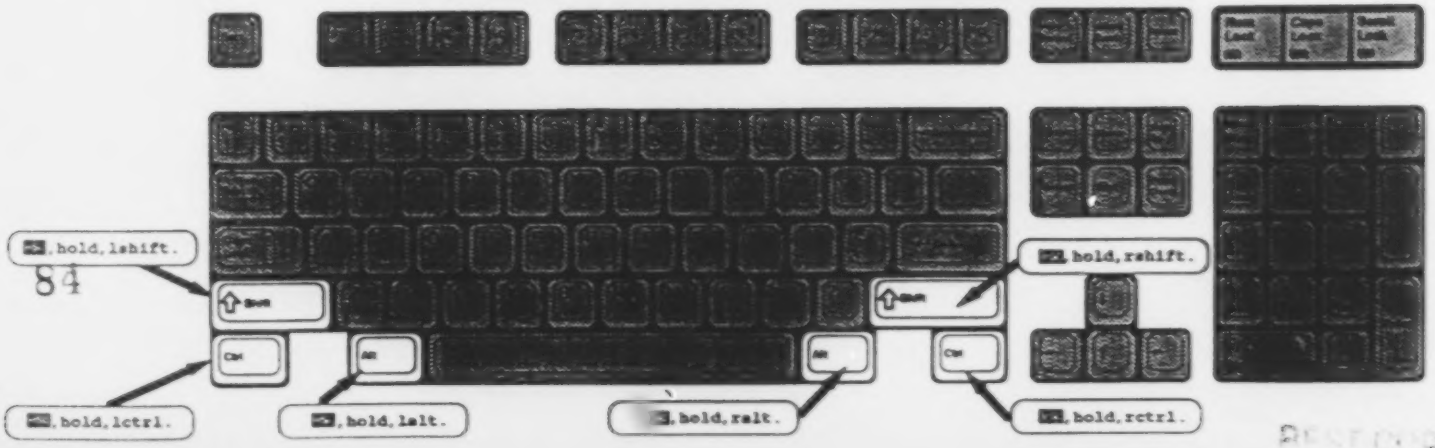
SerialKeys will hold down the SHIFT key down, type the H key, and finally release the SHIFT key.

Note

While we have just shown the strings for the modifier keys, any key can be used with the hold command. The format is:



Modifier Keys are shown in white. Some keyboards have separate left control (lctrl) and right control (rctrl) keys, and separate left alt (lalt) and right alt (ralt) keys.



84

85

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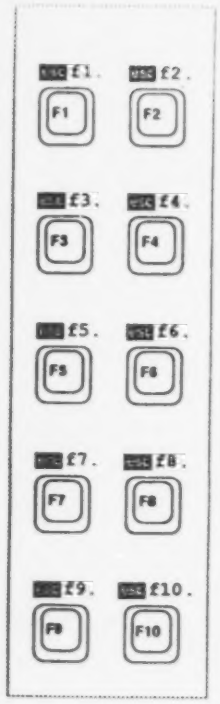
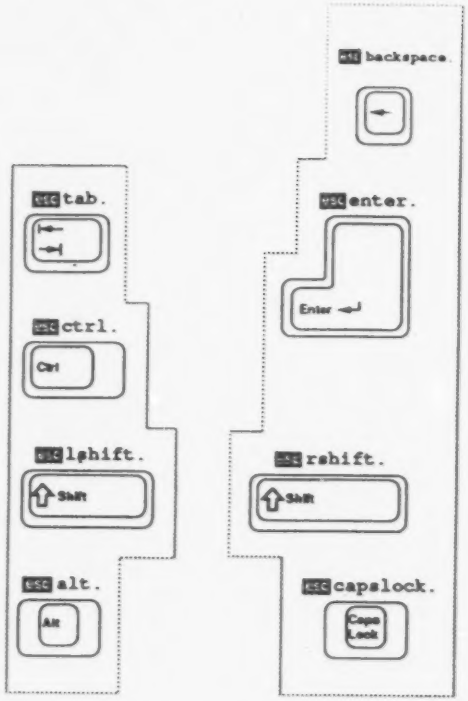
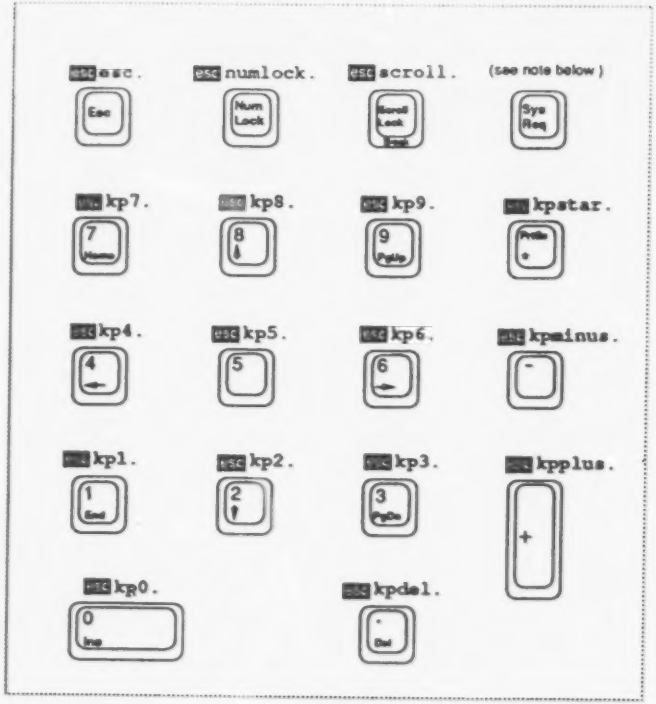
Typing Special Keys
IBM AT Keyboard (84 keys)



Function Keys



Modifier Keys and Miscellaneous Keys



Keypad Keys

To type the Sys Req key, store this string:

esc combine,alt,sysreq.

Special Keys - IBM AT Keyboard (84 keys) with Serialkeys sequences. Basic keys not shown.

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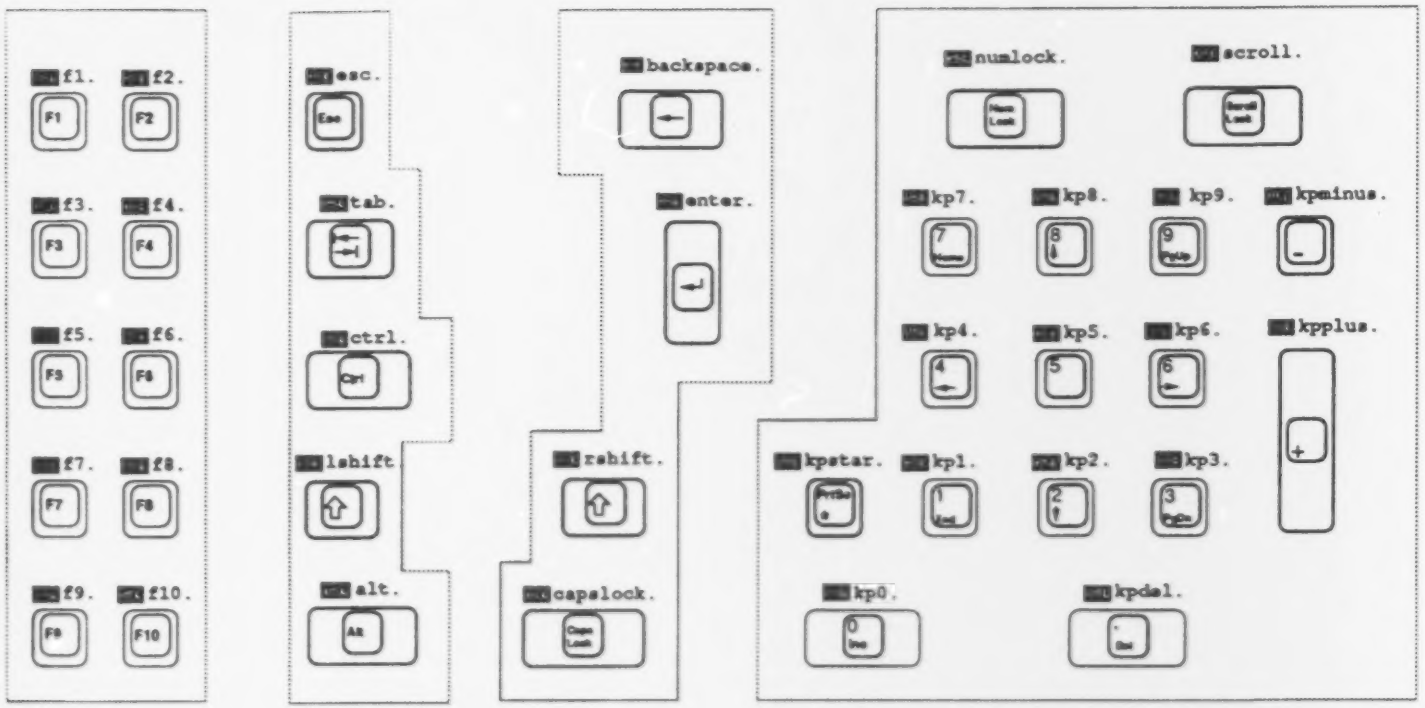
Typing Special Keys
IBM PC Keyboard (83 keys)



Special Keys - IBM PC Keyboard (83 keys)
with Serialkeys sequences.
Basic keys not shown.

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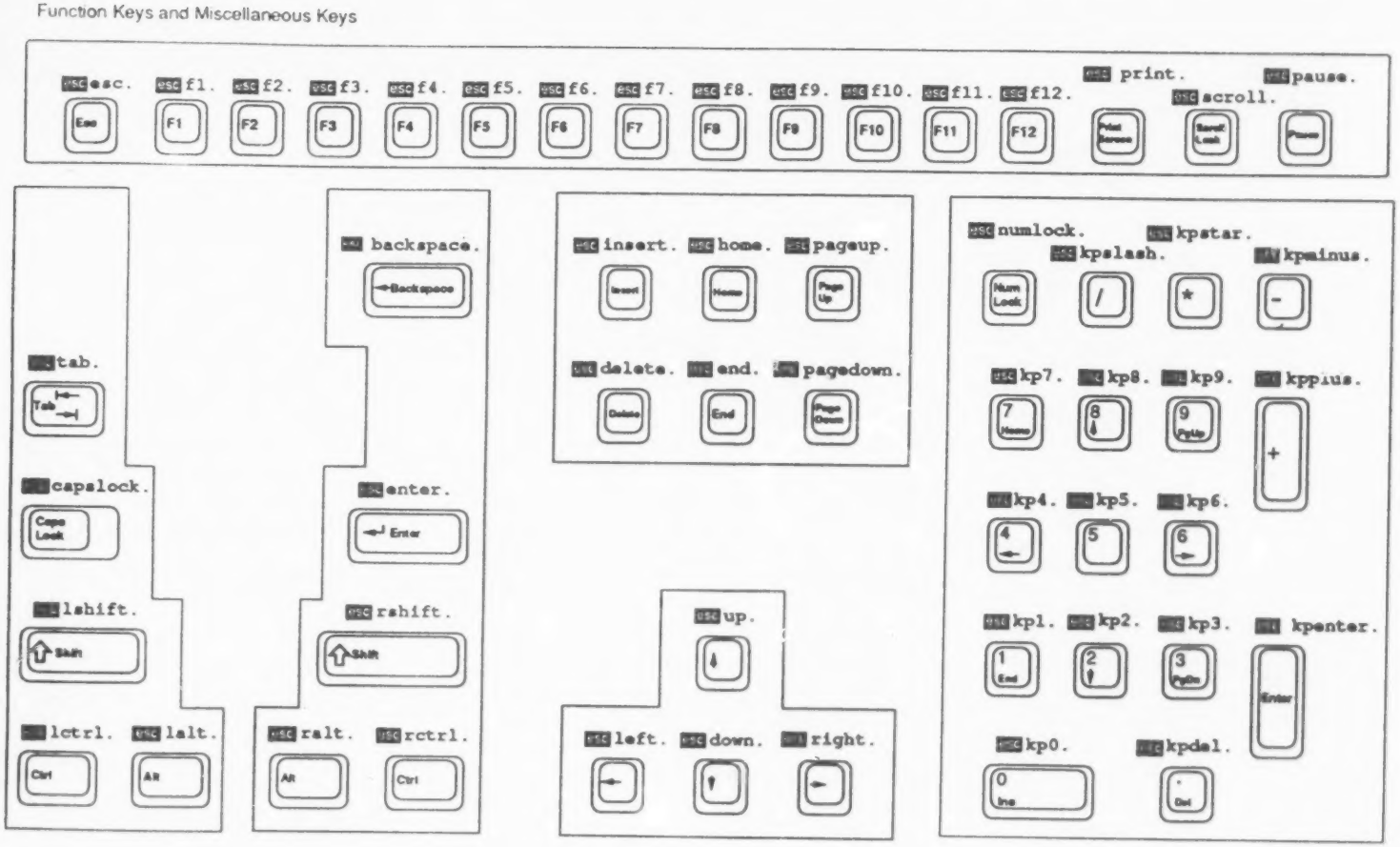
Typing Special Keys
IBM Enhanced Keyboard (101 keys)



Special Keys - IBM Enhanced Keyboard (101 keys) with Serialkeys sequences. Basic keys not shown.

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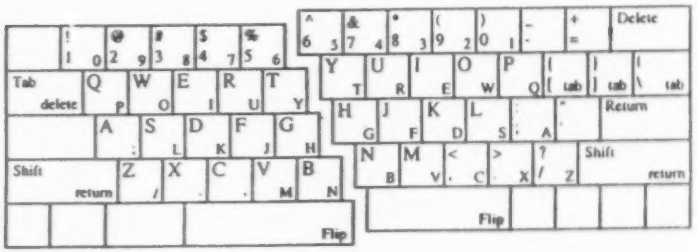
HOW DOES IT WORK...

The Half-QWERTY typing technique is very similar to the standard two-handed touch-typing technique...

You place your hand where it would normally be if you were touch-typing — that takes care of that half of the keyboard. To type the letters of the other half, you hold down the space bar and do the same finger movement that would normally be done by the other hand. Hitting the space bar alone still types a space.

Note that the relative finger movements used for one-handed typing are the same as those used for two-handed typing. So, if you're already a touch-typist, you already know them. You should be typing one-handed in a matter of minutes.



HOW FAST CAN I TYPE...

With practice, Half-QWERTY typists can expect to reach speeds of between 61% and 91% of those achievable by two-handed typists. Typing speeds as high as 64 words-per-minute (wpm) have been recorded.

CAN OTHER PEOPLE STILL USE MY KEYBOARD...

Yes.

The keyboard can still be used for two-handed typing. Half-QWERTY doesn't interfere.

USE EITHER HAND

Note that Half-QWERTY works with either hand. The software actually creates two virtual Half-QWERTY keyboards — one for each hand. This is done automatically, without instruction from the user.

STICKY KEYS

Sticky Keys is a feature that makes typing modifier-key sequences (e.g., capital letters) easier for one-handed typists—you no longer have to type the modifier (e.g., Shift, Control, Alt) and the modified key simultaneously. You can type them in one after the other.

Depressing and releasing a modifier key once makes it active for the next key you type. Pressing it twice locks it. Press it again to unlock it.

Sticky Keys is built into the Windows and DOS versions of Half-QWERTY. On the Macintosh, this feature is provided by the operating system.

CARPAL TUNNEL SYNDROME & OTHER HAND/ARM INJURIES

Carpal Tunnel Syndrome and other typing-related injuries don't always occur in both hands.

In cases where only one hand is affected, you can type with the other hand, while the injured one heals. Half-QWERTY's innovative "skill transfer" design makes the transition fast and easy.

Periodic rest breaks should be taken, so as not to risk injuring the uninjured hand.

BLINDNESS

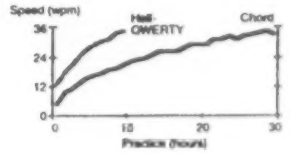
Used in conjunction with a Braille display, Half-QWERTY allows blind and visually impaired persons to read what they type as they are typing it, much as a seeing person would.

HOW FAST CAN I LEARN IT...

If you've never learned to type before, learning Half-QWERTY will take roughly the time it would take to learn standard two-handed touch-typing.

However, if you are a trained touch-typist, you can learn Half-QWERTY in a matter of minutes, with little or no retraining.

Published empirical research has shown that (on average) a touch-typist can learn Half-QWERTY in 1/3 the time it takes to learn a one-handed chord keyboard.



Half-QWERTY's innovative "skill transfer" design makes this possible...

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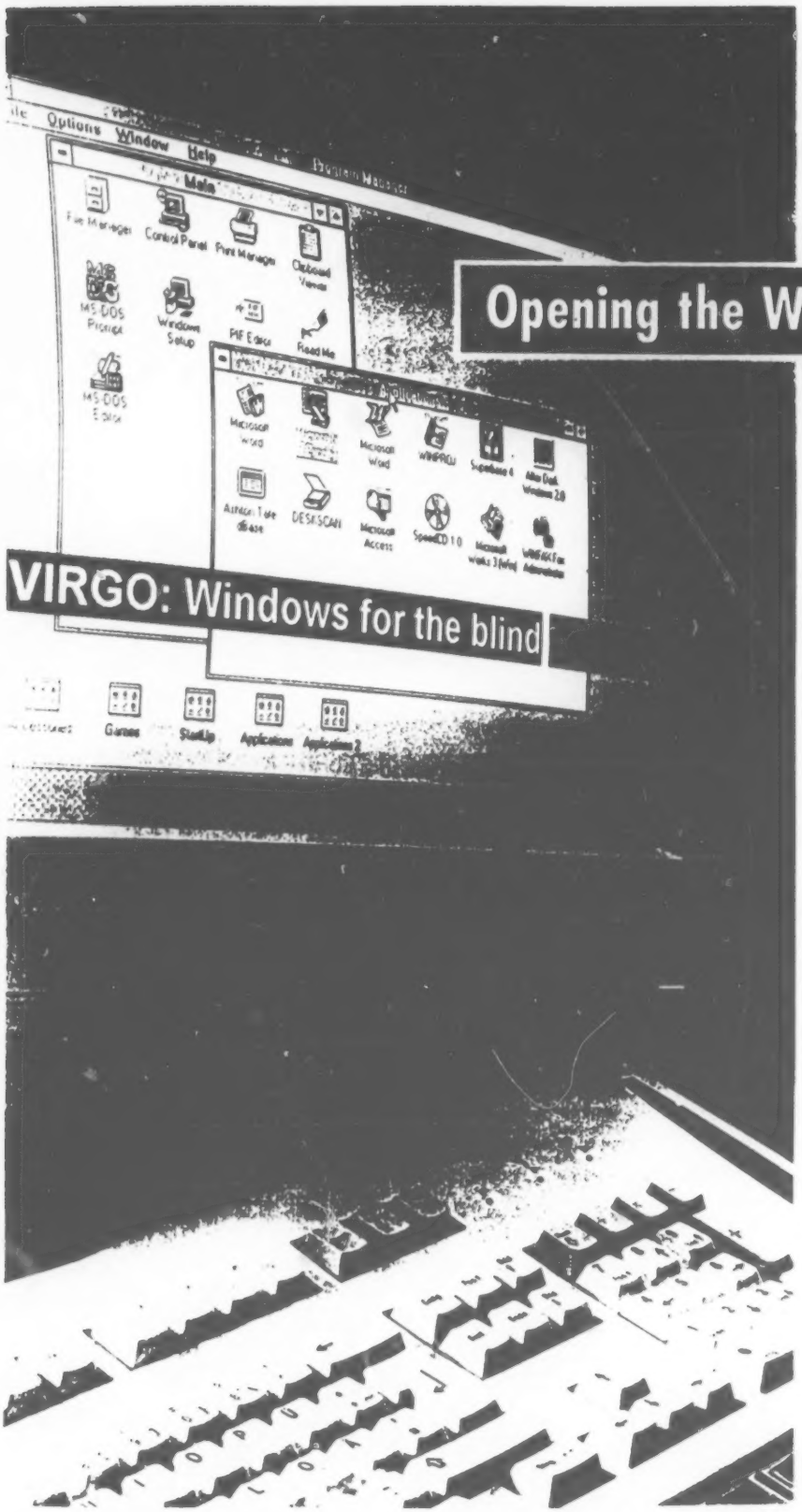

The Windows-Solution
for the Blind and
Visually Impaired

Opening the World of Windows

VIRGO

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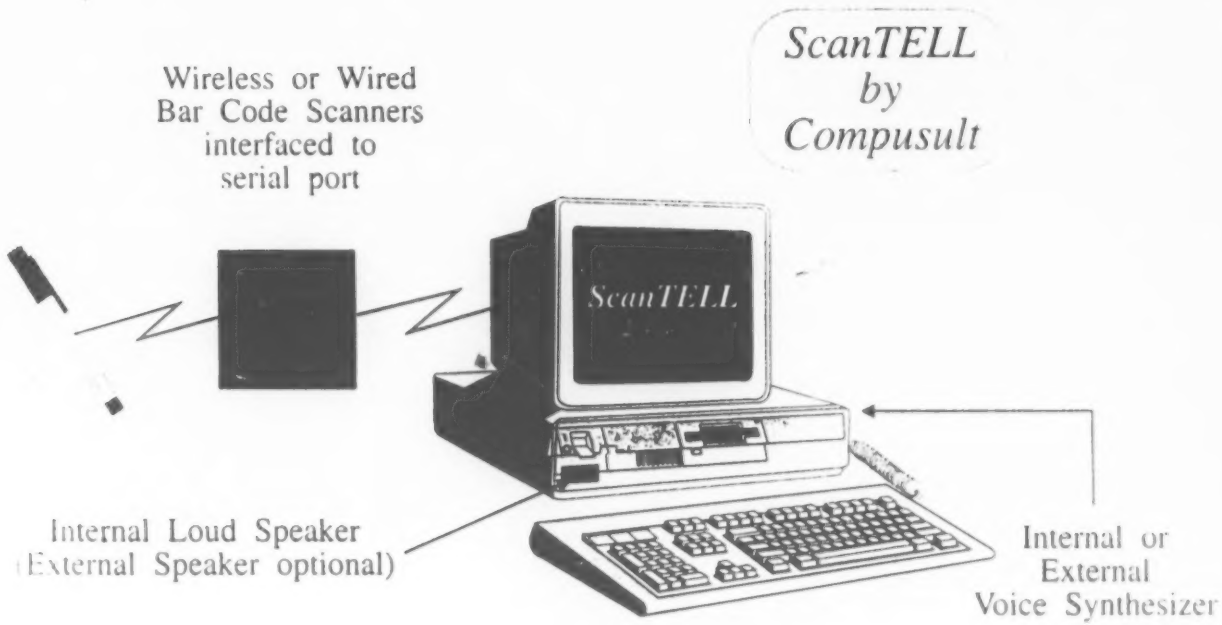

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HeadMouse™

HeadMouse™ for Portables

Head-Controlled Pointing for People with Disabilities

- **Optimized for Portable Computers**
- **Indoor and Outdoor Operation**
- **Directly Powered from Wheelchair Batteries**
- **Integrated Power Supply for Laptop Computers**
- **Wireless Operation**
- **No Cumbersome Head Mounted Apparatus**
- **Emulates:**
  - **Microsoft Mouse**
  - **IBM PS/2 Mouse**
  - **Apple Macintosh Mouse**

The HeadMouse sensor replaces a standard computer mouse for people who cannot use their hands. The HeadMouse is a device that translates the movements of a user's head into directly proportional movements of the computer mouse pointer. The HeadMouse is a *wireless* optical sensor which tracks a tiny and disposable target that is placed on the user's forehead or glasses. When this capability is combined with an on-screen keyboard, the HeadMouse can completely replace the functions of a conventional keyboard. On-screen keyboards provide an image of the keys on the computer display, with key selection made by positioning the mouse pointer over a key. The actual key press is implemented by dwelling over that key for a set period of time or by using an adaptive switch.

The HeadMouse for Portables has been optimized for use with laptop computers. The lightweight and rugged HeadMouse sensor is attached directly to the computer display. Power for the HeadMouse and computer is provided by the integrated power adapter which is connected directly to a wheelchair mounted battery.

The HeadMouse completely emulates the RS-232 serial Microsoft Mouse, the Apple Macintosh mouse and the IBM PS/2 mouse. Origin Instruments provides special Smart Cables for converting to the appropriate data format.

When the Head Mouse is used with on-screen keyboard software, all of the standard personal computer applications are available to the person with a disability.

Origin Instruments

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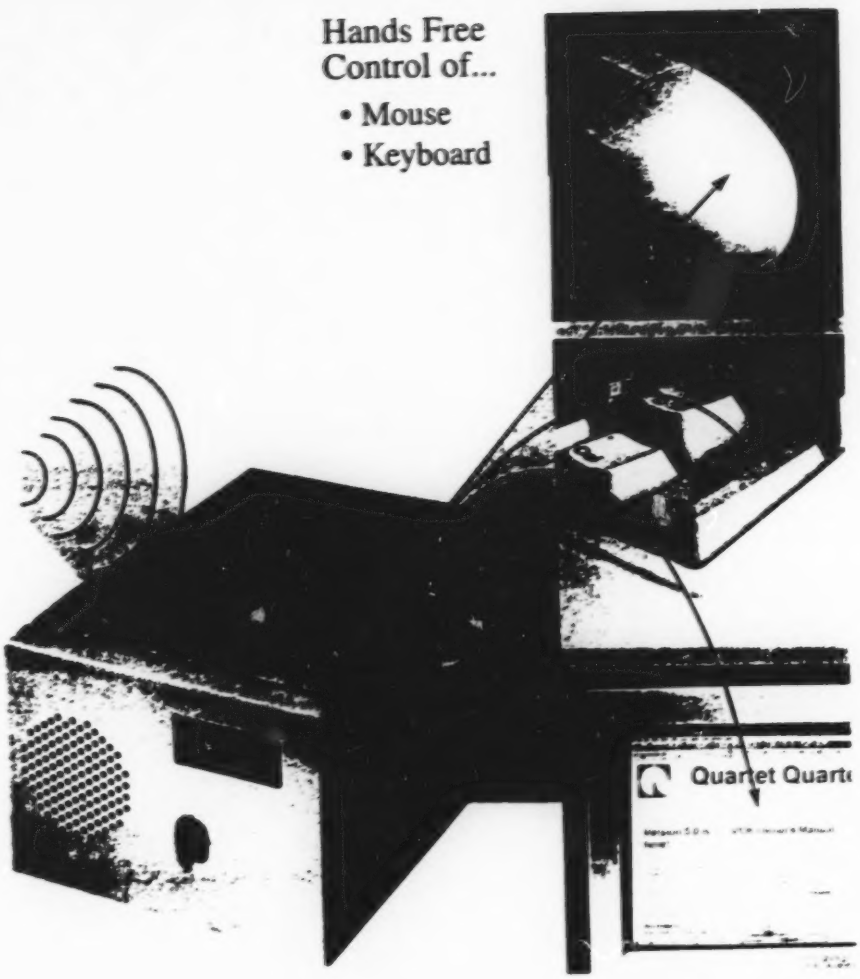
Hands Free
Control of...

- Mouse
- Keyboard



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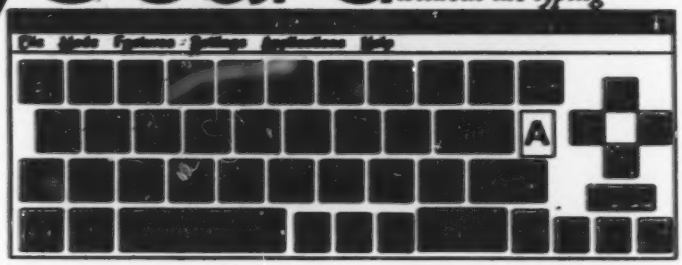
Adaptive Computer Systems
1835 Hafor Street
Iowa City, IA 52246

Voice: (319) 338-1449

Full computer access

Visual™ Keyboard

without the typing



EASIER TO USE

Type into any Windows application using a joystick, trackball, mouse, ability switch, or other input device. Visual Keyboard™ comes complete with point-and-click, dwell, and scanning capabilities.

NEW FEATURES

- **Visual Surfboard™**
  With a web browser (included), you can surf the Internet, use e-mail, download files with ftp, and login remotely with telnet.
- **EasyStart™**
  Launches and resizes your applications (e.g. Word, Excel, Lotus 1-2-3, Netscape, etc.) with a single click.
- **UniversalDwell™**
  Lets you use the commands and menus in your word processor, spreadsheet or in Windows itself.
- **Voice output** (voice board required)
- **FlexiPhrase™**
  You can select among variations of common phrases.

STANDARD FEATURES

- **Word prediction learns new words**
- **Abbreviation expansion** (one-keystroke)
- **Customizable library**
  Phrases for everyday use
- **Adjustable keyboard layout**
  Simply drag and drop to design your own layout. Alpha, QWERTY, and 2 frequency of use layouts included.
- **Automatic capitalization and punctuation**
  Cuts keystrokes by up to 50%!

AWARD WINNING

Visual Keyboard has been recognized by RESNA/Easter Seals and AAMI for overall design and keyboard layout.

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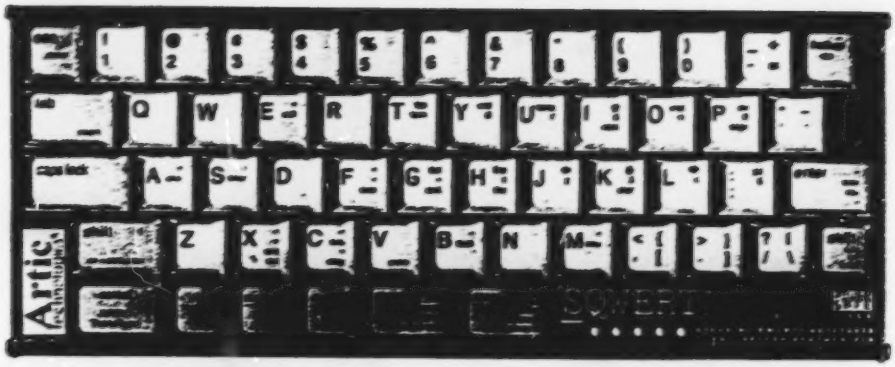
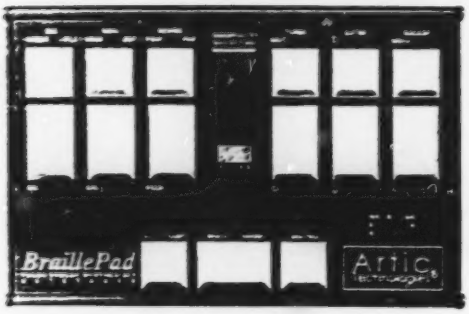


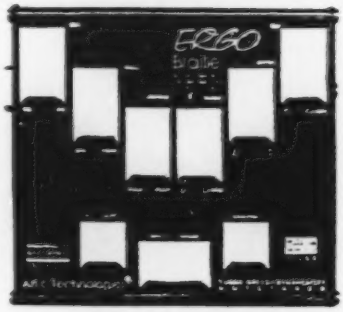
SQWERT - A Speaking QWERTY notetaker synthesizer.



BraillePAD

A COMPACT Braille keyboard with an embedded cursor pad.

- High Quality Braille Key Feel
- Grade-2 Back Translator
- High Speed Artic Speech
- Over 700K file space
- Rechargeable Battery
- Powerful editor & Menus
- Alarms, reminders, etc.
- Compatible with all DOS & Windows Access Programs
- Run Editor & PC Access without switching modes
- PC-File transfer built-in
- Other options available



ERGOBraille

The SMALLEST braille keyboard with an **ERGONOMIC** key layout.

These simple value-oriented speech devices are perfect for blind students and people who need to take notes, look up personal information or have pop-up reminders. The high quality feel of these keyboards will make long work days comfortable. All three devices also act as a ***TURBO SPEECH SYNTHESIZER FOR USE WITH ANY PC SCREEN ACCESS PROGRAM***. Each device features over ***700K OF POWER-SAFE FILE STORAGE*** and a modern editor with built-in text searches and instantaneous edit and insert anywhere. An efficient memory manager automatically allocates file space without any wasted memory. Programmable alarms and reminders can be useful for people with busy schedules. Built-in rechargeable NiCad batteries will give you a busy day of use without wall power. The Braille Devices include a Grade-2 back translator. A terminal program and other software options are available.

Artic Technologies 55 Park Street, Troy, Michigan 48083 (810) 588-7370

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Gus! Talking Keyboard for Windows...

New! *Printing feature!*
New! *DECtalk Speech Option***

The Gus! Talking Keyboard combines an on-screen keyboard with an exceptionally clear synthetic voice. The speech synthesizer is available in English Male, English Female, French (Parisian), German and Spanish (Latin American) versions. Upcoming versions include Castillian Spanish, Japanese, Italian and British English. Includes Gus! SpeakClip, an "always on top" utility that enables speech output from any Windows application and quick access to Gus software (right).

Speech Output - Male or female (Speech synthesizer included!)

Change font style and size

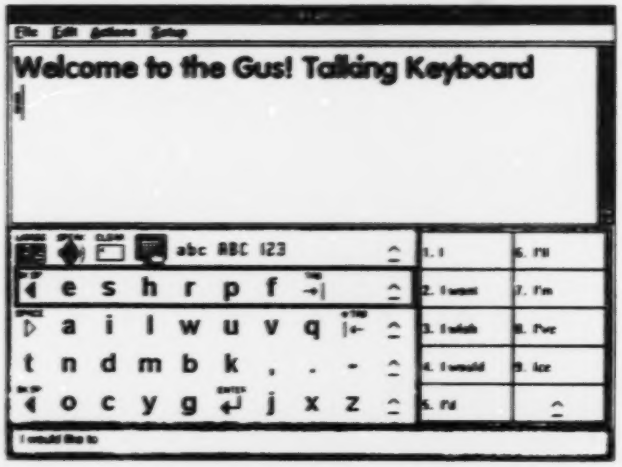
Save and retrieve text files

Speak any combination of letter, word or sentence

1 and 2 switch scanning with "on-the-fly" speed adjustments

Includes Gus! Mouse (PC switch interface)

Direct link to the Gus! Multimedia Speech System



Word prediction

Sentence prediction

Abbreviated expansion (with Gus! Abbreviations)

Learns new words as you type! (with unlimited vocabulary)

Automatic capitalization

Automatic spacing after punctuation

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